CHAPTER 75

LIST OF EFFECTIVE TEMPORARY REVISIONS

FOLLOWING IS A COMPLETE LISTING OF ALL ACTIVE TEMPORARY REVISIONS (TR'S). TR'S NOT LISTED SHOULD BE REMOVED. THE ATA NUMBER, CONFIG CODE AND PAGE NUMBER IDENTIFIES THE PAGE PRECEDING THE TR.

TR NUMBER	ATA NUMBER	CONFIG CODE	PAGE NUMBER	TR DATE

NONE

CHAPTER 75

AIR

LIST OF EFFECTIVE PAGES

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CHAPTER 75

AIR

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AIR - DESCRIPTION AND OPERATION

1. General

Air required for aircraft and engine services is taken from offtakes positioned around the gas generator.

The main offtakes supply 7th stage I.P. and 6th stage H.P. compressor air through the engine and power plant ducts (Ref. fig.1) for the systems listed below and described in the Chapter/Sections shown.

Engine inlet anti-icing system	30-21-00
Engine bleed air system	36-11-00
Accessory cooling system	75-21-00
Thrust reverser	78-30-00
Engine starting system	80-11-00

Additional independent offtakes on the gas generator provide 7th stage I.P. compressor air and 3rd and 6th stage H.P. compressor air to the following systems:

Fuel control system	73-21-00
I.P. compressor airflow control system	75-31-00
H.P. compressor airflow control system	75-32-00

Tappings, either directly from the gas generator or from air supplies to systems, provide air for the Compressor Delivery Pressure AIDS (Ref. 75-42-00).

The temperature of the I.P. and H.P. compressor delivery air is sensed by two thermocouples that provide signals for the Compressor Delivery Temperature AIDS (Ref. 75-43-00).

The temperature of the air used for internal cooling of the engine, is sensed by two thermocouples that provide signals for the Turbine Temperature AIDS (Ref. 75-44-00).

Non-return valves are fitted in both main offtake ducts to prevent air entering the compressors from the ducts.

Gimbal joints are incorporated in the main offtake ducts to cater for working movement and E type seals are interposed between all mating duct and gimbal Vee flanges to prevent air leakage. The mating Vee flanges are secured by Vee band coupling clamps (Ref. 70-12-02).

2. Description

A. Engine H.P. Air Duct

The engine H.P. air duct is located in zones 412, 422 and 432 and comprises an outlet tube, an elbow assembly and a split housing (Ref. fig.1).

The inner end of the outlet tube locates with an aperture in the front inner combustion case that connects internally with the 6th stage of the H.P. compressor. The outer end of the tube is secured to the combustion outer case.

The split housing and the elbow assembly mate with a flange on the outer end of the outlet tube and are secured to the combustion outer case.

The split housing, which surrounds the elbow assembly to reduce leakage into the engine Zone 2 (Ref. 75-21-00) in the event of the H.P. duct failure, mates at its outer end with the interservices fairing floor. Additional support for the housing is provided by two half clamps fitted around its mid section.

The elbow assembly comprises a gimbal joint and a tapered duct. The outer end of the assembly incorporates a Vee flange to facilitate connection to the power plant duct.

Yellow flashes are painted on the elbow to aid correct alignment with the power plant duct during assembly.

B. Engine I.P. Air Duct

The engine I.P. air duct (Ref. fig.1) is located in zones 412, 422 and 432. The inner end of the duct is secured to the intermediate case and mates with an aperture that connects internally with the 7th stage of the I.P. compressor. The duct incorporates an offtake that provides a reference pressure to the H.P. valve (Ref. 36-11-00) and a Vee flange to facilitate connection to the I.P. power plant duct gimbal joint. 2

Yellow flashes are painted on the duct to aid correct alignment with the gimbal joint during installation.

C. Power Plant Air Ducts

The power plant air ducts are located in zones 412, 422 and 432 and consists of the H.P. air duct and the I.P. air duct.

H.P. Air Duct

The H.P. air duct (Ref. fig.1) comprises a duct assembly that incorporates two offtakes, and an S duct that incorporates two integral gimbal joints. Each duct incorporates a mall Vee flange at one end and a female Vee flange at the other end.

The duct assembly is secured by coupling clamps to the engine H.P. elbow assembly at the inner end and to the H.P. valve at the outer end. Yellow flashes are painted adjacent to the mating flanges to aid alignment during installation. A non-return valve is interposed between the mating Vee flanges of the engine H.P. elbow assembly and the duct assembly. The large offtake on the duct assembly supplies air to the thrust reverser and the small offtake supplies a sensing signal to the H.P. overpressure switch (Ref. 36-11-00).

The lower flange of the S duct is secured to the H.P. valve outlet and the upper flange to the engine bleed air system duct (Ref. 36-11-00) by coupling clamps. The S duct is supported by a cable suspended from the hoop plate. The cable is secured to a lug on the S duct and prevents stressing of the duct coupling clamps and gimbal joints during power plant removal and installation.

I.P. Air Duct

The I.P. air duct (Ref. fig.1) comprises a gimbal joint and a duct assembly that incorporates a male Vee flange at one end and a female Vee flange at the other. The gimbal joint is secured by coupling clamps to the engine I.P. duct at the inner end and to the duct assembly at the outer end.

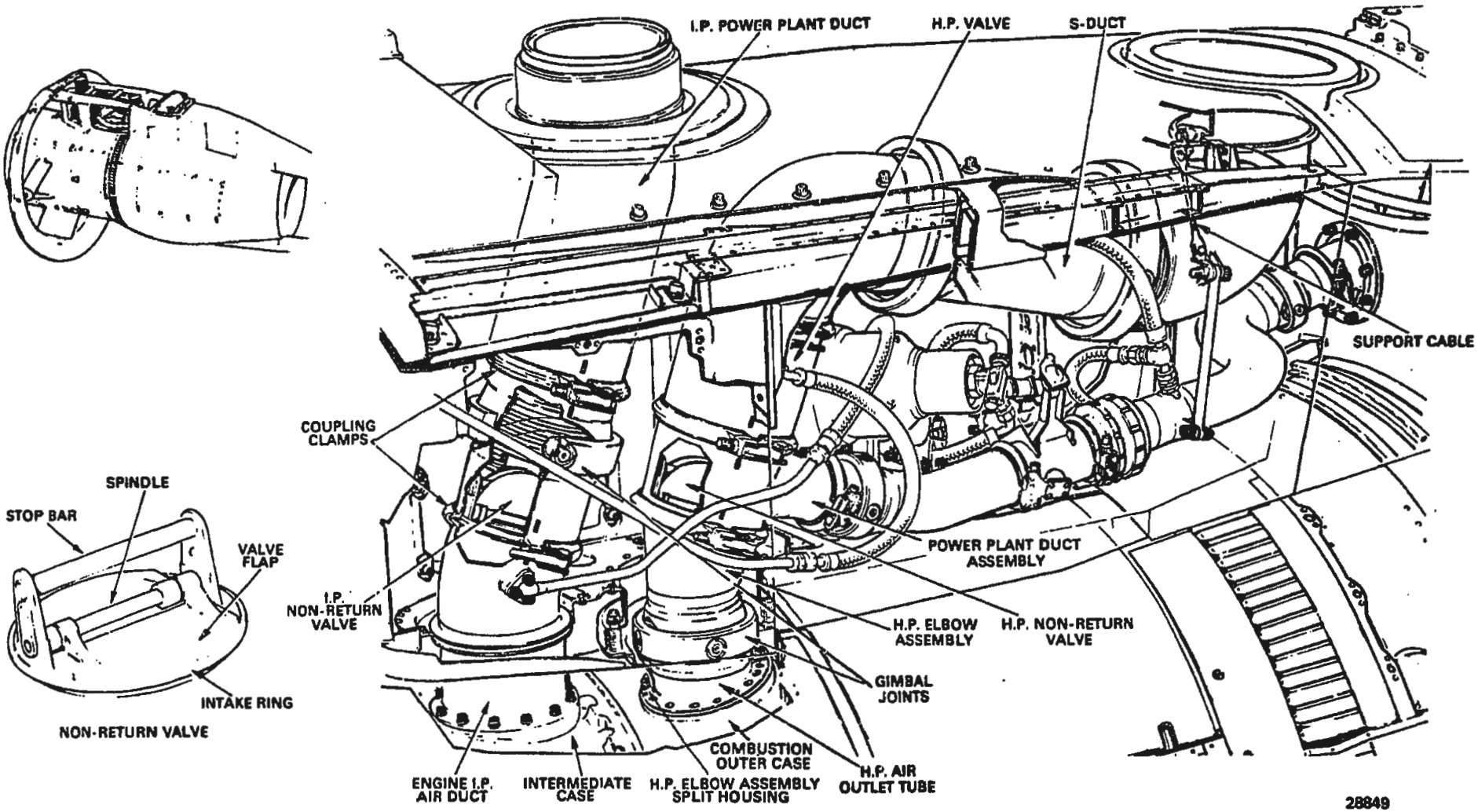
2

Yellow flashes are painted adjacent to the mating flanges to aid alignment during assembly. A non-return valve is interposed between the mating Vee flanges of the engine I.P. duct and the gimbal joint. The outer end of the duct assembly is secured to the engine bleed air system (Ref. 36-11-00) by a Vee clamp.

D. I.P. and H.P. Non-return Valves

The I.P. and H.P. non-return valves are identical. Each valve (Ref. fig.1) consists of an intake ring that incorporates two integral supports. The supports are drilled to accommodate a stop bar and a spindle which carries two valve flaps. A pin that protrudes from the downstream side of the intake ring locates with a recess in the duct Vee flange to aid correct installation.

During engine running the valves flaps are held open against the stop bar by compressor air pressure. When the engine is stationary the flaps close and form a seal with the seating surface of the intake ring to prevent any air present in the ducts entering the compressors.



Main air offtakes
Fig.1

HIGH PRESSURE AND INTERMEDIATE PRESSURE NON-RETURN VALVE - MAINTENANCE PRACTICES

1. Removal/Installation High Pressure (H.P.) and Intermediate Pressure (I.P.) Non-Return Valve (N.R.V.)

WARNING: ENSURE THRUST REVERSER SYSTEM IS LOCKED IN THE FORWARD THRUST POSITION (REF. 78-30-00, SERVICING) WHILE WORK IS IN PROGRESS.

A. Remove H.P. and I.P. N.R.V.

(1) Equipment required:

CP.20309 Working platform

(2) Tag throttle control levers and throttle reverser levers. Tag APU/GRD AIR TO REVERSERS switches

(3) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag appropriate START AIR VALVE circuit breaker

(4) Tag appropriate ENGINE START panel switchlights

(5) On Flight Engineer/Second Officers BLEED AIR PANEL depress appropriate HI PRESS VALVE switchlight to OFF to close the high pressure shut-off valve

NOTE: The appropriate HI PRESS VALVE circuit breaker on the pilots overhead circuit breaker panel CB1, zone 210, must be energized.

(6) On pilots overhead circuit breaker panel CB1, zone 210, open and tag appropriate HI PRESS VALVE circuit breaker

(7) Position working platform in cold stream duct

(8) Enter cold stream duct, remove interservices fairing left-hand and right-hand, front and rear access panels (Ref. 72-03-00)

(9) Refer to fig.201, remove clamps (1) (Ref. 70-12-02).

(10) Carefully remove gimbal joint (2).

(11) Remove non-return valve (3) from gimbal joint (2).

(12) Remove H.P. valve (Ref. 36-11-01).

(13) Disconnect connector (4).

(14) Remove clamps (5) and (6) (Ref. 70-12-02).

(15) Retain non-return valve (3) in duct (7); remove non-return valve and duct from H.P. duct.

(16) Remove non-return valve (3) from duct (7).

B. Install H.P. and I.P. N.R.V.

(1) Equipment required:

CP.20309 Working platform

(2) Ensure working platform is positioned in cold stream duct.

(3) Ensure appropriate systems are tagged as detailed in A.(2) through (6).

(4) Enter cold stream duct and remove, if fitted, all blanks from exposed apertures and connectors.

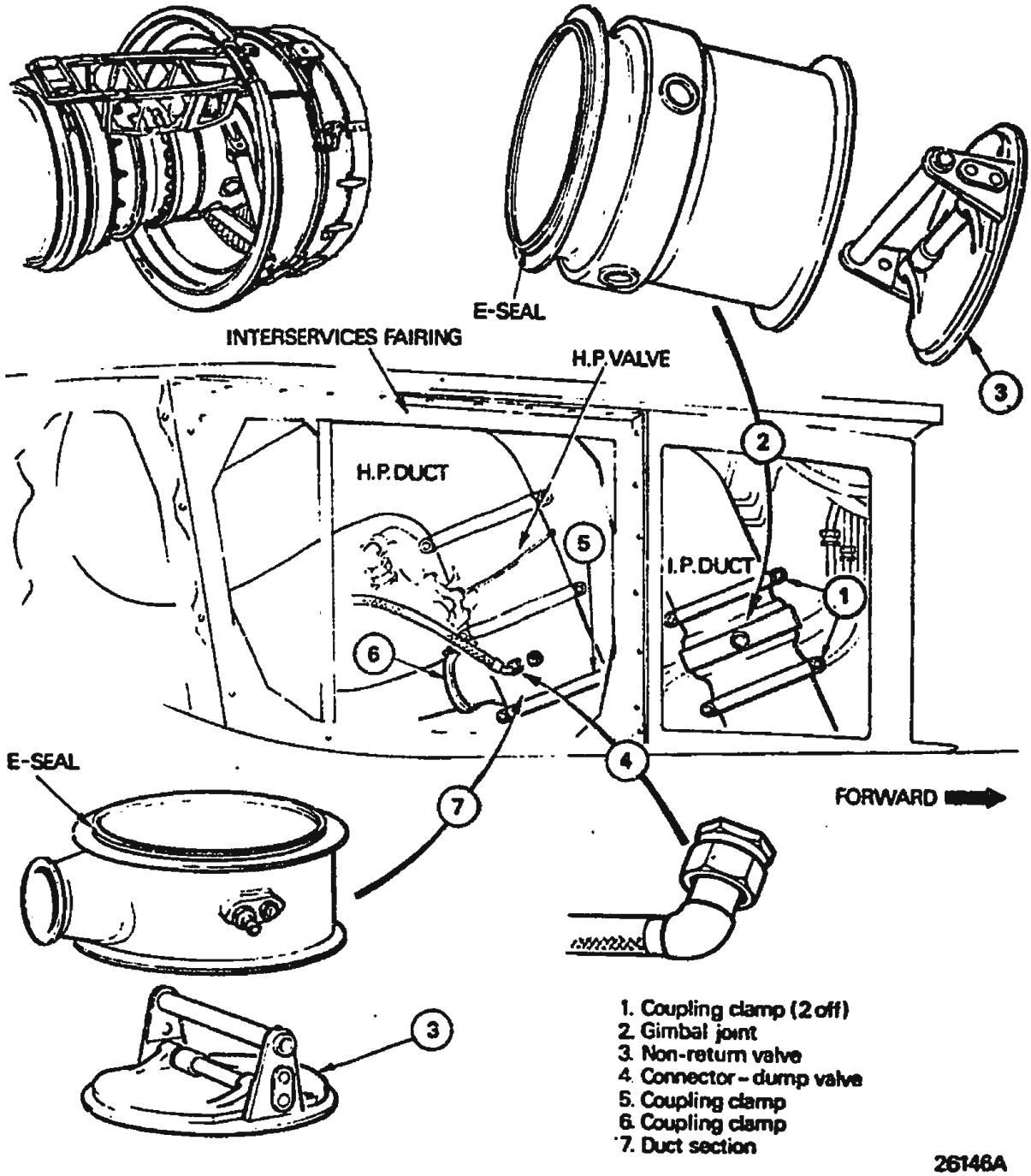
(5) Refer to fig.201, check E-seals (Ref. 70-12-02) in H.P. duct male flanges.

(6) Prepare clamps (5) and (6) and mating faces for fitment (Ref. 70-12-02).

(7) Position non-return valve (3) in duct section (7), ensuring positive location of dowel.

(8) Retain non-return valve (3) in duct (7); position duct to H.P. duct, secure with clamps (5) and (6), torque tighten (Ref. 70-12-02).

(9) Fit H.P. valve (Ref. 36-11-01).



H.P. and I.P. non-return valve removal/installation
Fig.201

(10) Connect and secure connector (4) (Ref. 71-50-00)

(11) Check (Ref. 70-12-02) E-seals in I.P. duct, and gimbal joint, male flanges

(12) Prepare clamps (1) and mating faces for fitment (Ref. 70-12-02).

(13) Position non-return valve (3) in I.P. duct, ensuring positive location of dowel

(14) Position gimbal joint (2) to I.P. duct, secure with clamps and torque tighten (Ref. 70-12-02)

(15) Pressurize N.R.V.'s from A.P.U. or external air supply (Ref. 36-11-00) check for leaks at points disturbed.

(16) Fit interservices fairing left-hand and right-hand, front and rear access panels (Ref. 72-03-00)

(17) Ensure tags are removed and circuit breakers closed for appropriate system as detailed in A.(2) through (6)

(18) Remove working platform

(19) Before next flight operationally test N.R.V's within bleed air system (Ref. 36-11-00)

ENGINE ANTI-ICING SYSTEM - DESCRIPTION AND OPERATION

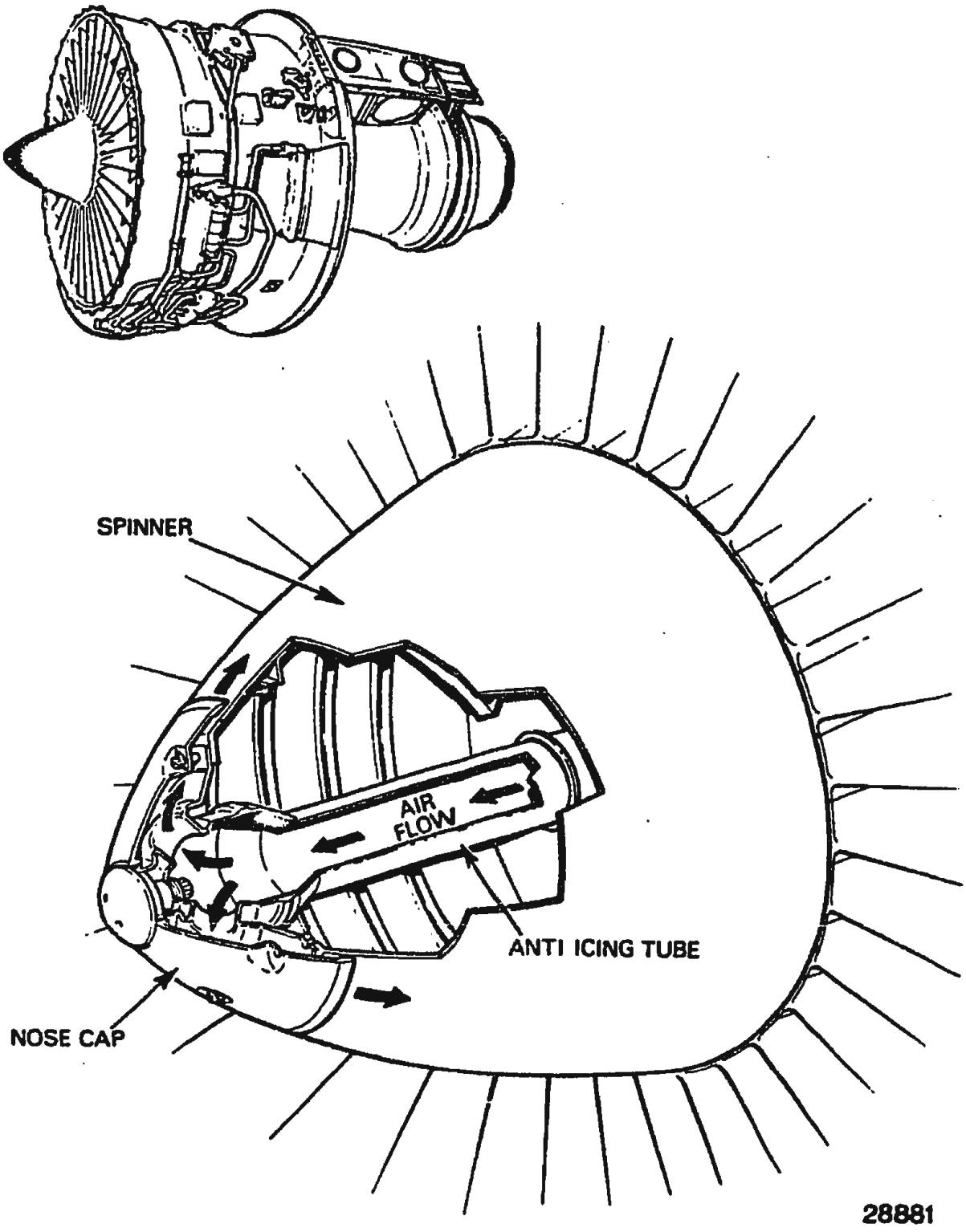
1. General

Engine anti-icing is effected by a continuous flow of hot air, taken internally from the I.P. compressor and exhausted over the outer surface of the L.P. compressor spinner.

The spinner is illustrated in fig.1.

2. Description

The spinner is located in zones 412, 422 and 432, on the front of the L.P. compressor. Air taken from the I.P. compressor internal cooling and sealing air supply (Ref. 72-02-00) flows forward, through the centre of the L.P. compressor fail safe shaft assembly, to a tube in the spinner as illustrated in fig.1. The air passes through the tube and flows over the outside of the spinner from a gap formed between the spinner and the nose cap.



Engine anti-icing system
Fig.1

ACCESSORY COOLING SYSTEM - DESCRIPTION AND OPERATION

1. General

Environmental cooling for engine-mounted accessories and purging hazardous vapors from the power plant is accomplished by the circulation of fresh air. Calibrated airflow is provided to five zones into which each power plant is divided. Outside air is circulated in one zone when the aircraft is in flight through a combination of ram and ejector methods. Low-pressure (LP) compressor delivery air serves as the ventilating medium for the four other zones. The temperature of the cooling air passing from zone 3 to zone 4a is monitored by the bleed air overheat warning system (Ref. 36-22-00).

The five zones are defined as follows:

A. Zone 1 is generally the area surrounding the LP compressor (fan) case up to the firewall and thrust reverser (T/R) diaphragm. For engines No. 1 and 3, the envelope consists of the nose cowl rear diaphragm, the engine firewall and T/R diaphragm, the forward section of the pylon firewall, and the hinged cowl panels (Ref. Fig. 1). For engine No. 2, the zone is bounded by the canted bulkhead firewall (FS 1989), the engine firewall and T/R diaphragm, the center engine support structure (CESS) lower bulkhead, and six hinged and fixed cowl panels (Ref. Fig. 2). The fan case comprises the inner envelope limit for Zone 1 on each of the three engines.

Positive cooling and ventilating airflow around the LP compressor case and accessories is ensured by the Zone 1 system.

B. Zone 2 is the area encompassed by the intermediate-pressure (IP) and high-pressure (HP) module cases and the compressor/combustion chamber (gas generator) fairings. The compressor section lower fairing surrounding the external gearbox drive is included. The aft extremity of Zone 2 is the fireseal at the rear of the combustion section.

Air circulation through this zone is provided to lower temperatures on the compressor/combustion chamber cases and to decrease any possibility of vapor ignition by reducing the dwell time of leaked fuel or oil.

C. Zone 3 involves the interior of the interservices fairing (splitter) area forward of the pylon diaphragm. The gas generator upper combustion fairing, the base of the hoop plate, and the front face of the pylon diaphragm, combined

with the splitter access panels, form the envelope for Zone 3.

This zone ensures a positive airflow through the interservices fairing area to cool components and provide an acceptable dilution factor in the event of air offtake duct leakage. Zone 3 air also maintains a positive pressure differential relative to Zone 2 to prevent entry of leaked oil or fuel.

D. Zone 4a consists of a small area formed by the fireseal at the rear of the combustion chamber, the rear mount ring (exhaust case) except for the area around the rear engine mount, and the gas generator turbine fairings. Positive cooling and ventilating airflow around the turbine section is ensured by the arrangement of this zone. Turbine case temperatures are effectively controlled, and the possibility of ignition hazard is decreased by reduction of the dwell time of any leaked oil. A positive pressure differential relative to Zone 2 prevents the inflow of oil or fuel.

E. Zone 4b consists of the area formed by the pylon fairing diaphragm, the rear mount ring (exhaust case), and the end of interface and stang fairings. The positive movement of air through Zone 4b ensures the cooling of the rear engine mount, accessories, the exhaust transition case, and the hot-stream collector assembly.

2. Engines No. 1 and 3

The flowpaths (Ref. Fig. 1) of the cooling and ventilating air through each cooling zone are as follows:

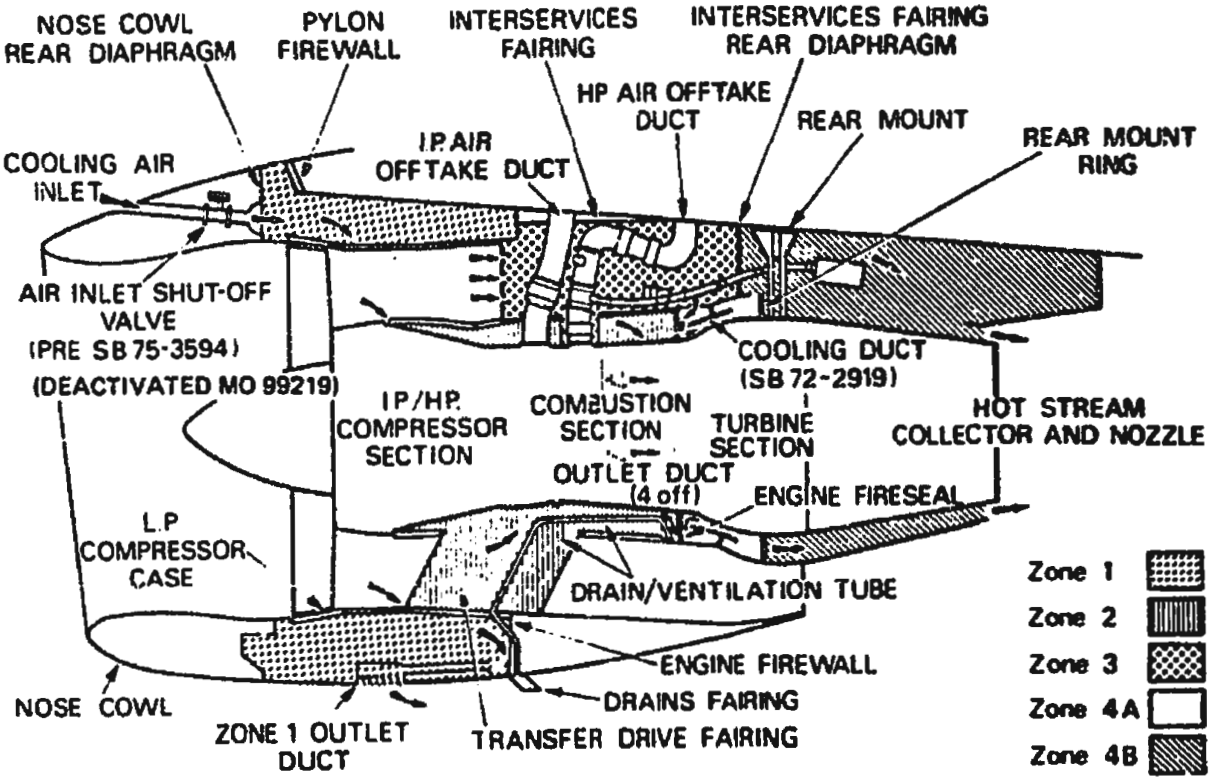
A. Zone 1

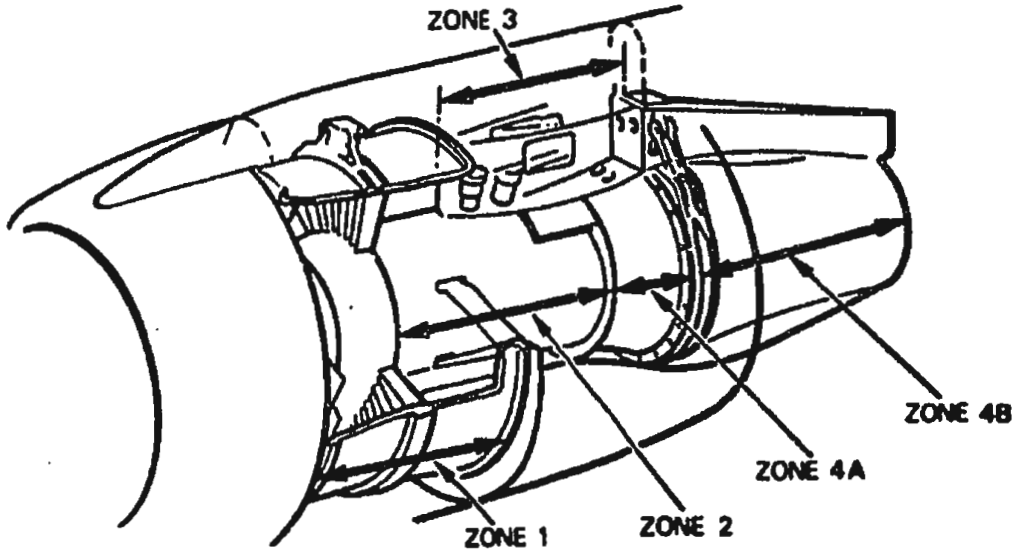
Air enters the nose cowl cooling air inlet, zones 411 and 421, and flows through the air inlet shutoff valve and the ventilation duct into Zone 1. The airflow is provided by ram air when the aircraft is airborne.

R NOTE: On engines with RR SB75-3594, the air inlet shut-off valve is replaced by a short duct.

(1) Ram Air System

In flight, the ram effect of the air at the cooling air inlet provides the cooling and ventilating airflow through Zone 1. The air flows through the zone and exhausts to atmosphere through the ejector duct.





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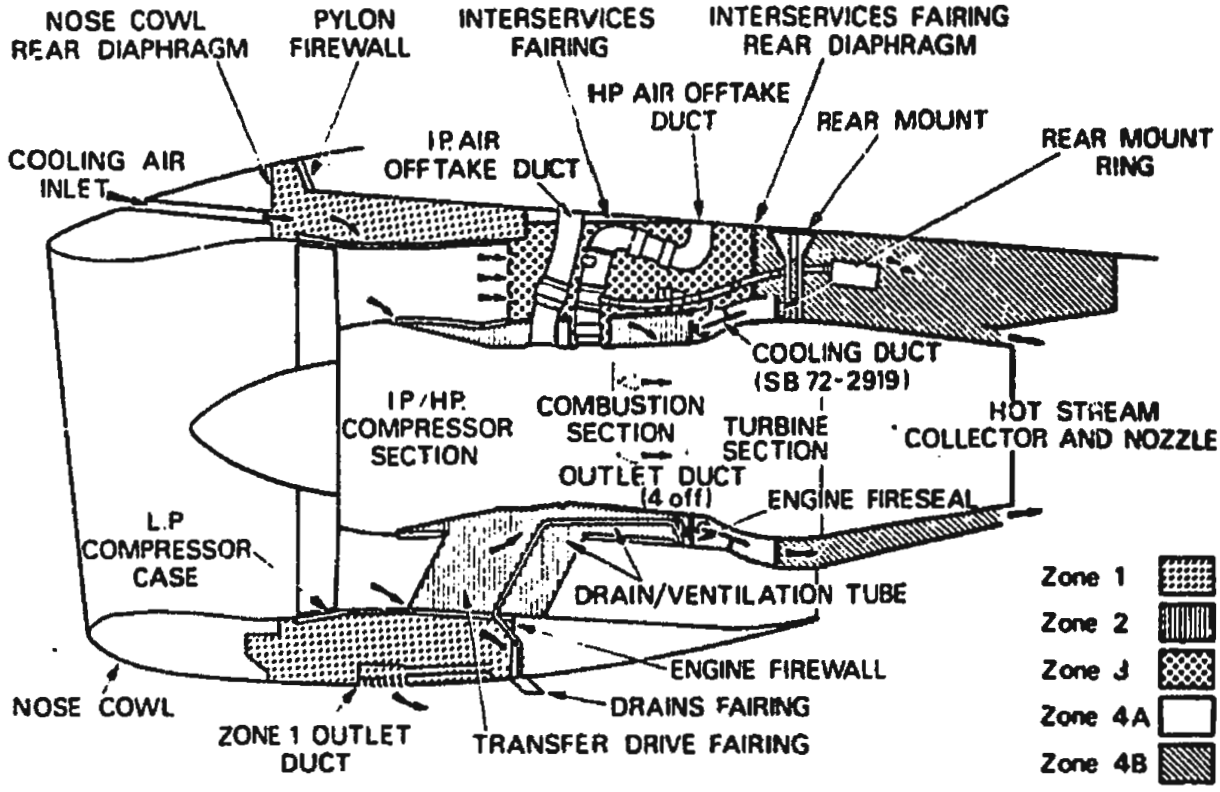
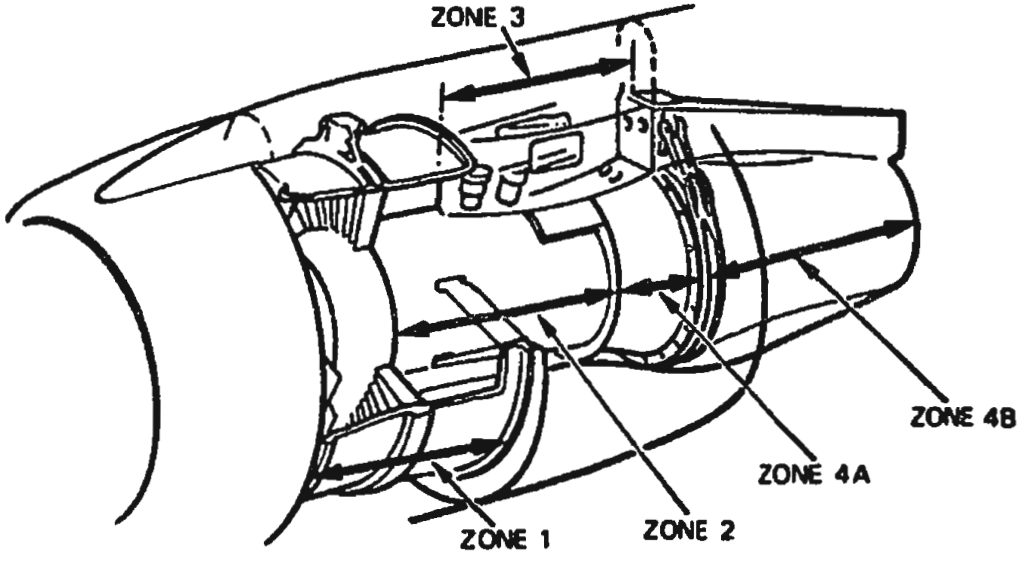
CR Accessory Cooling System Zones and Airflow (Engines No. 1 and 3)
CR Figure 1

EFFECTIVITY: ALL

0018





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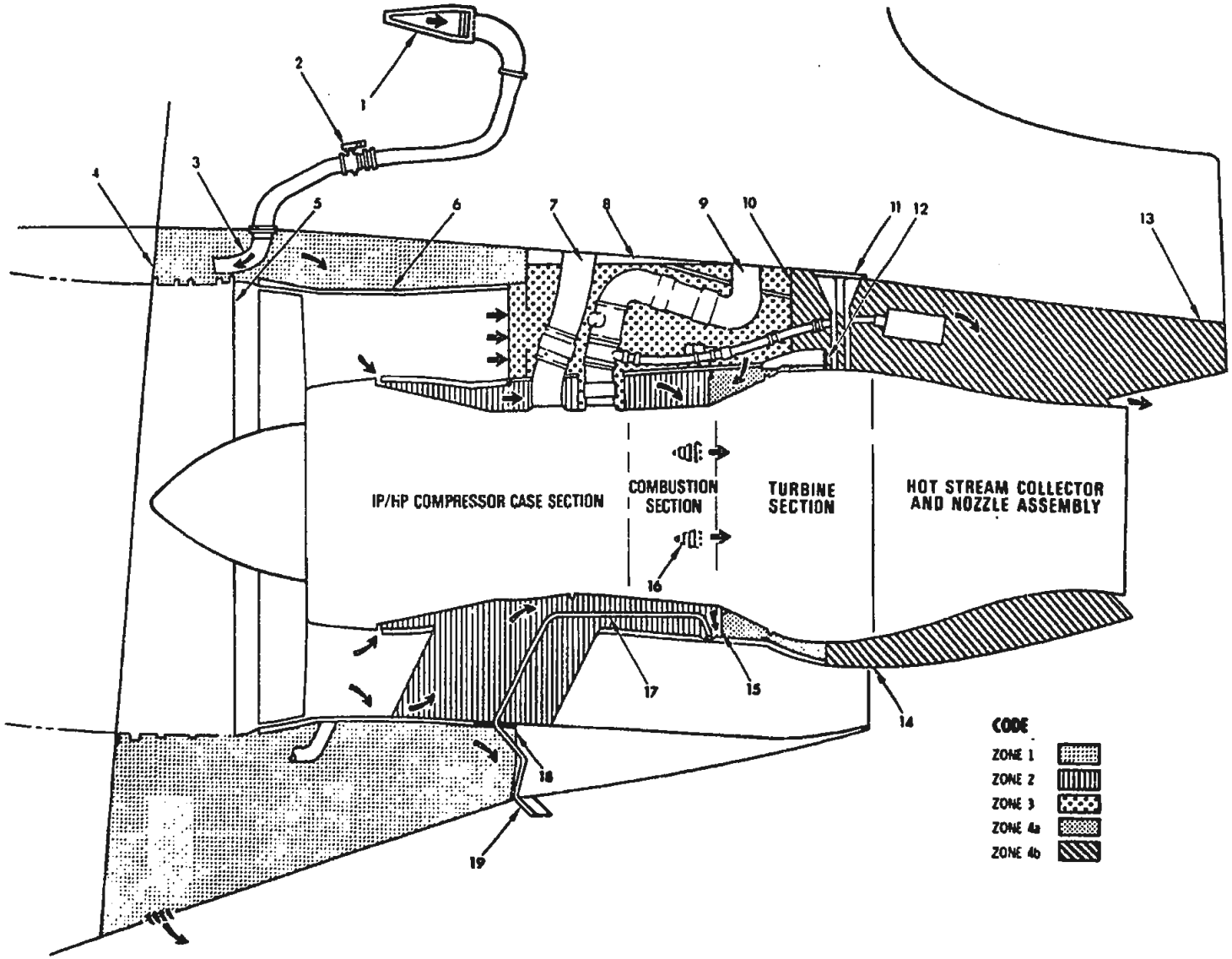
R Accessory Cooling System Zones and Airflow (Engines No. 1 and 3)
R Figure 1

EFFECTIVITY: ENGINES WITH RR SB75-3594



1 COOLING AIR INLET
2 AIR INLET SHUT-OFF VALVE (DEACTIVATED M099219)
3 ZONE 1 AIR VENTILATION DUCT
4 FS 1989 CANTED BULKHEAD (FIREWALL)
5 AIR INTAKE (S-DUCT) ADAPTER
6 LP COMPRESSOR CASE
7 IP AIR DUCT
8 HOOP PLATE
9 HP AIR DUCT
10 PYLON DIAPHRAGM
11 REAR MOUNT
12 REAR MOUNT RING
13 INTERFACE FAIRING
14 FIRESEAL VENT
15 FIRESEAL
16 OUTLET DUCT (4)
17 DRAIN VENTILATION TUBE
18 FIREWALL AND THRUST REVERSER DIAPHRAGM
19 DRAINS MAST

M1-0001-75-019

CR Accessory Cooling System Zones and Airflow (Engine No. 2)
CR Figure 2

EFFECTIVITY: ALL

001B

B. Zone 2

The LP compressor delivery air enters Zone 2 through the joints between the gas generator compressor fairings and passes rearwards over the compressor and combustion sections. The air leaves the rear of the zone through four rearward facing outlet ducts in the gas generator combustion fairings, that exhaust into the LP compressor outlet duct, and through the combined drain/ventilation tube which exhausts to atmosphere through the drains fairing.

C. Zone 3

The LP compressor delivery air enters the interservices fairing through holes in the nose section and flows rearwards through Zone 3. The majority of the air discharges through holes in the pylon floor into Zone 4a, and the remainder discharges through clearance holes in the pylon diaphragm, around the air motor supply tube and flexible drives, into Zone 4b.

D. Zone 4a

R The cooling airflow for Zone 4a is provided by air entering from Zone 3. The air flows over the turbine section and discharges into Zone 4b through holes in the rear mount ring.

On engines with RR SB72-2919 (Introduction of Convection Cooling Ducting), the air entering from Zone 3 flows between the cooling duct and the turbine case and discharges into Zone 4b through holes in the rear mount ring.

E. Zone 4b

The cooling airflow for Zone 4b is provided by the air entering from Zones 3 and 4a, passing rearwards and exhausting to atmosphere through the annular space between the hot stream collector and the collector fairing.

3. Engine No. 2

The majority of accessories for engine No. 2 are located in power plant Zone 1 on the low-pressure (LP) compressor (fan) case. The chamber around the fan case, zone 430, between the canted bulkhead and the engine firewall comprises Zone 1 of the power plant (Ref. Fig. 2).

Ram airflow from a flush-mounted inlet on the left side of the center engine support structure fairing, zone 470, is used for Zone 1 ventilation when the aircraft is airborne (Ref. Fig. 3).

NOTE: On aircraft 001-031 without SB26-016, in flight, ram air flows from the inlet to the air inlet shutoff valve located in the center engine support structure, zone 471. Downstream from the valve, ram air enters the power plant plenum chamber at the upper right side. Air exhausts overboard through the lower right section of the chamber. Airflow into the chamber is blocked when the air inlet shutoff valve is actuated by pulling the engine No. 2 emergency pull handle shutoff control, zone 21-LT4 (Ref. Fig. 4).

NOTE: On aircraft 001-031 with SB26-016 and 032-999, engine No. 2 air inlet shutoff valve is removed and a section of duct is installed.

Zones 2 through 4b function in the same manner as described for engines No. 1 and 3 in Paragraph 2.

C 4. On aircraft 001-031 without SB26-016 and RR SB75-3594, Air Inlet Shutoff Valve (Deactivated M099219)

A. Description and Operation

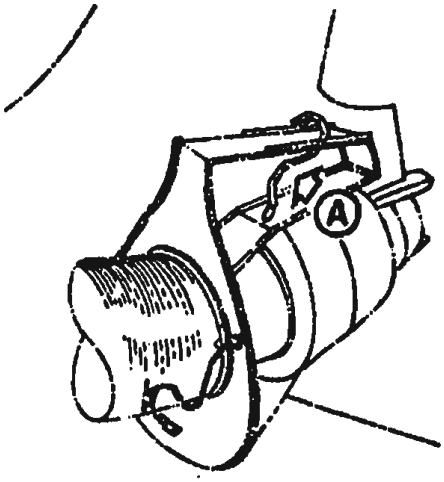
A motorized shutoff valve is provided to terminate the air supply to Zone 1, in the event of engine fire.

The valve body (Ref. Fig. 5) houses a butterfly valve, the position of which is determined by a rotary actuator incorporating a 28V dc reversible motor. The angular movement of the output shaft is controlled by limit switches fitted inside the actuator body. A slot in the end of the output shaft relates to marks on the actuator cover to provide visual indication of the actuator and butterfly valve position. The marks consist of an O for open and a C for closed.

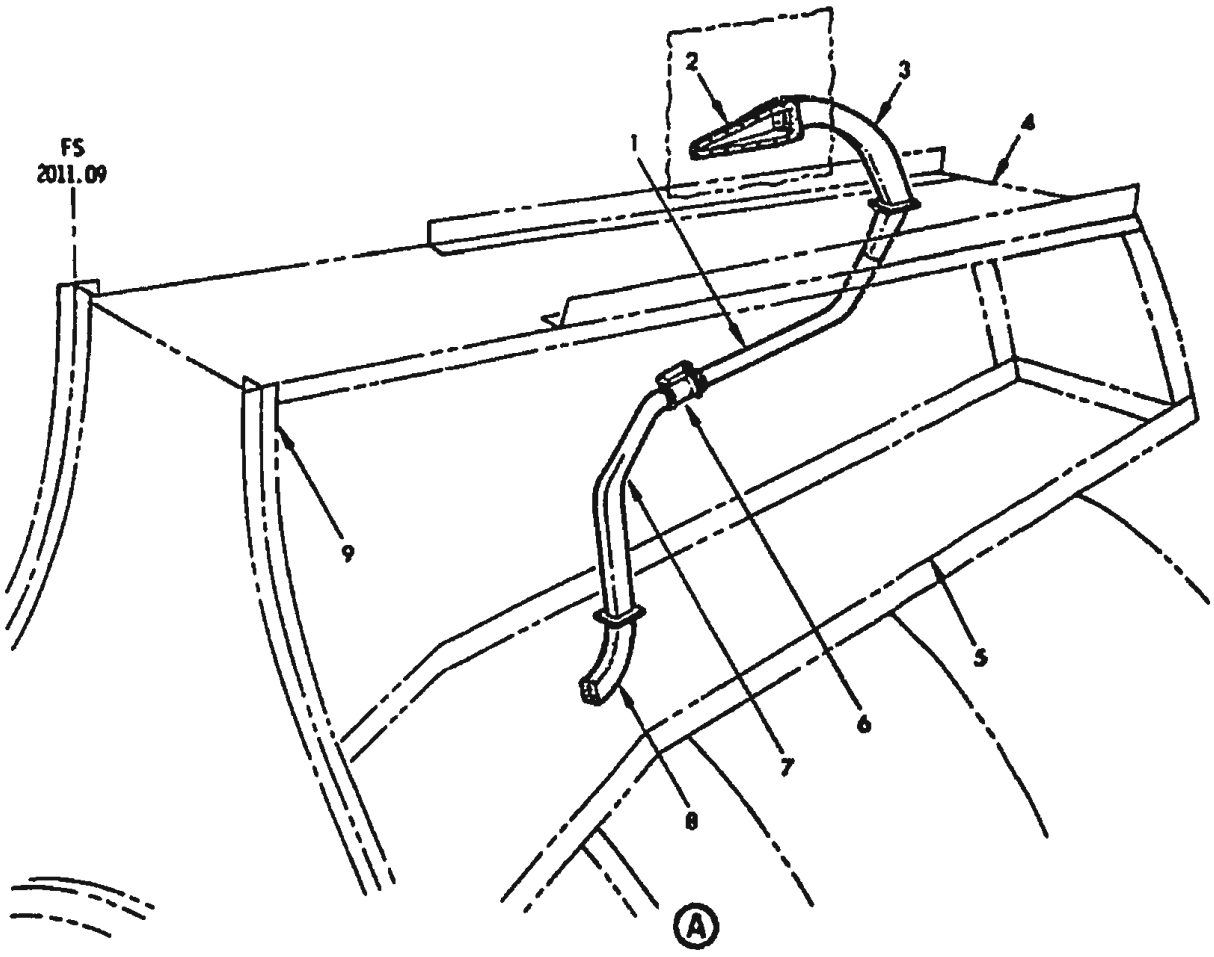
The electrical supply to the valve is controlled by the corresponding fire emergency engine shutoff control handle, zone 210. When pulled, the control handle connects a supply to the valve-closing circuit which energizes the actuator motor to close the butterfly valve. When the closed position is reached, the electrical supply to the actuator motor is broken by the 'closed' limit switch. In this position, the butterfly valve prevents airflow into Zone 1.

Movement of the control handle to the normal position connects an electrical supply to the valve-opening circuit,

1 VENTILATION AIR DUCT
2 FLUSH-MOUNTED AIR INLET
3 INLET VENTILATION AIR DUCT
4 CENTER ENGINE SUPPORT STRUCTURE UPPER RIB (REF.)
5 CENTER ENGINE SUPPORT STRUCTURE LOWER RIB (REF.)
6 AIR INLET SHUTOFF VALVE (DEACTIVATED MO 99219)
7 VENTILATION AIR DUCT
8 ACCESSORY COMPARTMENT VENTILATION AIR DUCT (OUTLET)
9 CANTED BULKHEAD FIREWALL (REF.)
10 THROUGH 16 NOT SHOWN ON THIS SHEET



ZONE 430



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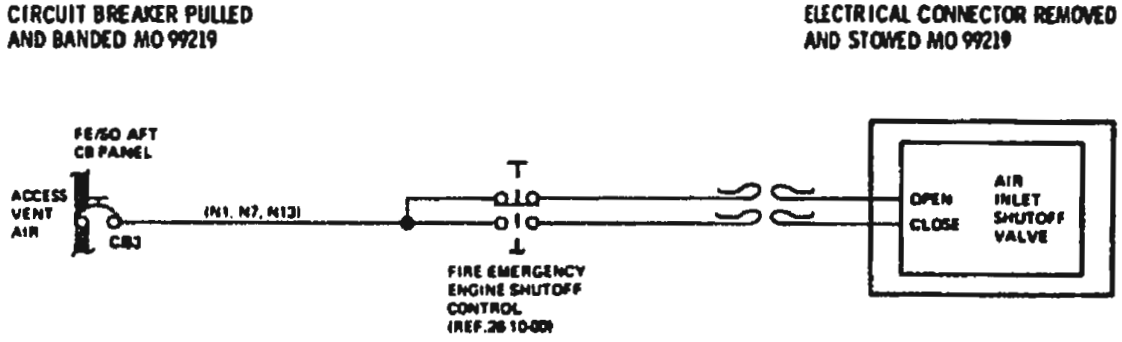
CR Engine No. 2 Accessory Cooling (Ventilating) System Components
CR Figure 3

which energizes the actuator motor to open the butterfly valve. When the open position is reached, the electrical supply to the motor is broken by the 'open' limit switch.

5. Air Inlet Ducting (Engines No. 1 and No. 3)

A. Description and Operation

R On engines without RR SB75-3594,
R the air inlet ducting, located in zones 411 and 421, connects to the nose cowl cooling air inlet at the forward end and the air inlet shutoff valve at the rear end. The ducting is secured to the valve inlet by a flexible coupling assembly. The valve outlet is connected by a double T-bolt V-band coupling to a ventilation duct integral with the front face of the nose cowl rear diaphragm (Ref. 71-11-00). The semicircular cross-section manifold extends through an arc of 135 degrees at the top of the rear diaphragm. Ten holes drilled in the diaphragm allow the cooling air to pass
R into Zone 1. On engines with RR SB71-2486 (Revised rear diaphragm and shortened ventilation duct),
the ventilation duct is bolted to the rear diaphragm and the cooling air enters Zone 1 through two holes in the diaphragm.



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CR Accessory Cooling Simplified Schematic
CR Figure 4

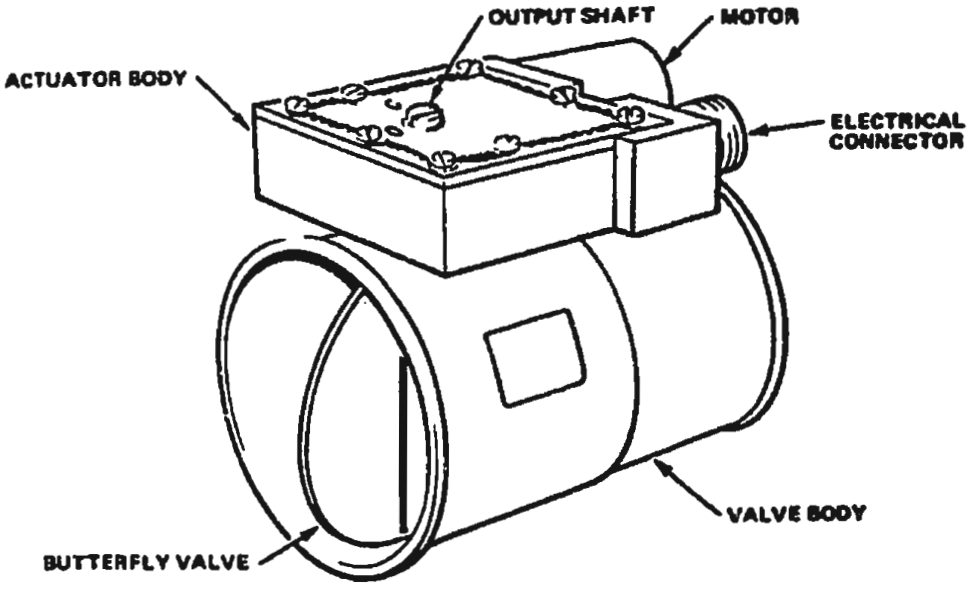
On engines with RR SB71-2660 (Introduction of ventilation nozzle),
the diameter of the holes in the diaphragm are increased and a nozzle assembly is secured over the upper of the two holes to direct the airflow towards the right-hand side of the zone.

On engines with RR SB75-3594,
the air inlet ducting, located in zones 411 and 421, connects to the nose cowl cooling air inlet at the forward end and to a ventilation duct integral with the front face of the nose cowl rear diaphragm. The semicircular cross-section manifold extends through an arc of 135 degrees at the top of the rear diaphragm. Ten holes drilled in the diaphragm allow the cooling air to pass into Zone 1.

6. Air Inlet Ducting (Engine No. 2)

A. Description and Operation

The air inlet ducting for Zone 1 ventilation on Engine No. 2 consists of a flush-mounted air inlet, three separate ventilation air ducts, and an accessory compartment ventilation air duct outlet. The inlet (Ref. Fig. 3),



⚠1 SHUTOFF VALVE FOR AIRCRAFT WITHOUT SB26-016 AND RR SB75-3594

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M1-0002-75-013

R Air Inlet Shutoff Valve (AIRCRAFT WITH RB.211-22B ENGINES)
R Figure 5

R which is of the NASA low-drag configuration, is mounted on
R the left side of the center engine support structure (CESS).

R NOTE: On aircraft 001-031 without SB26-016,
R two rigid ducts connect the inlet to the air inlet shutoff valve (Ref. Para. 4). The third rigid duct connects the valve to the perforated outlet in Zone 1.

R NOTE: On aircraft 001-031 with SB26-016 and 032-999,
R engine No. 2 air inlet shutoff valve is removed and a
R section of duct is installed.

ACCESSORY COOLING SYSTEM - MAINTENANCE PRACTICES

1. General

The following procedure specifies the method used to deactivate the engine accessory cooling system air inlet shutoff valve.

NOTE: This deactivation procedure applies only when an aircraft
CR is to be dispatched in accordance with the MEL. 2.
CR Deactivation (Valve is deactivated per MO 99219)

A. Air Inlet Shutoff Valve

(1) On aircraft 001-002,
On pilots overhead circuit breaker panel CB1, zone 215, open and tag applicable circuit breaker ACCESS VENT AIR (H13, H14, or H15).

(1) On aircraft 003-999,
on Flight Engineer/Second Officer aft circuit breaker panel CB3, zone 215, open and tag applicable circuit breaker ACCESS VENT AIR (N1, N7, or N13).

(2) Install air inlet shutoff valve inoperative placard.

(3) Make entry in aircraft maintenance log.

AIR INLET SHUTOFF VALVE (ZONE 1), ENGINES NO. 1 AND 3 REMOVAL AND INSTALLATION

1. Equipment and Materials

Strap wrench

Silicone grease, MIL-L-4343B, or equivalent

Lock-wire, Fed Spec QQ-W-390, 0.032-inch diameter, or equivalent

Protective caps

2. Referenced Procedures

20-21-01 Swaged Flexible Coupling - Removal and Installation

75-21-04 Air Inlet Shutoff Valve (Zone 1), Engines No. 1 and 3 - Adjustment and Test

3. Removal/Installation

CAUTION: CARE MUST BE TAKEN TO PREVENT DAMAGE TO SURFACES WHICH CONTACT THE SEAL RINGS.

A. Removal

(1) On the Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag the applicable circuit breaker engine ACCESS VENT AIR (N1, or N13).

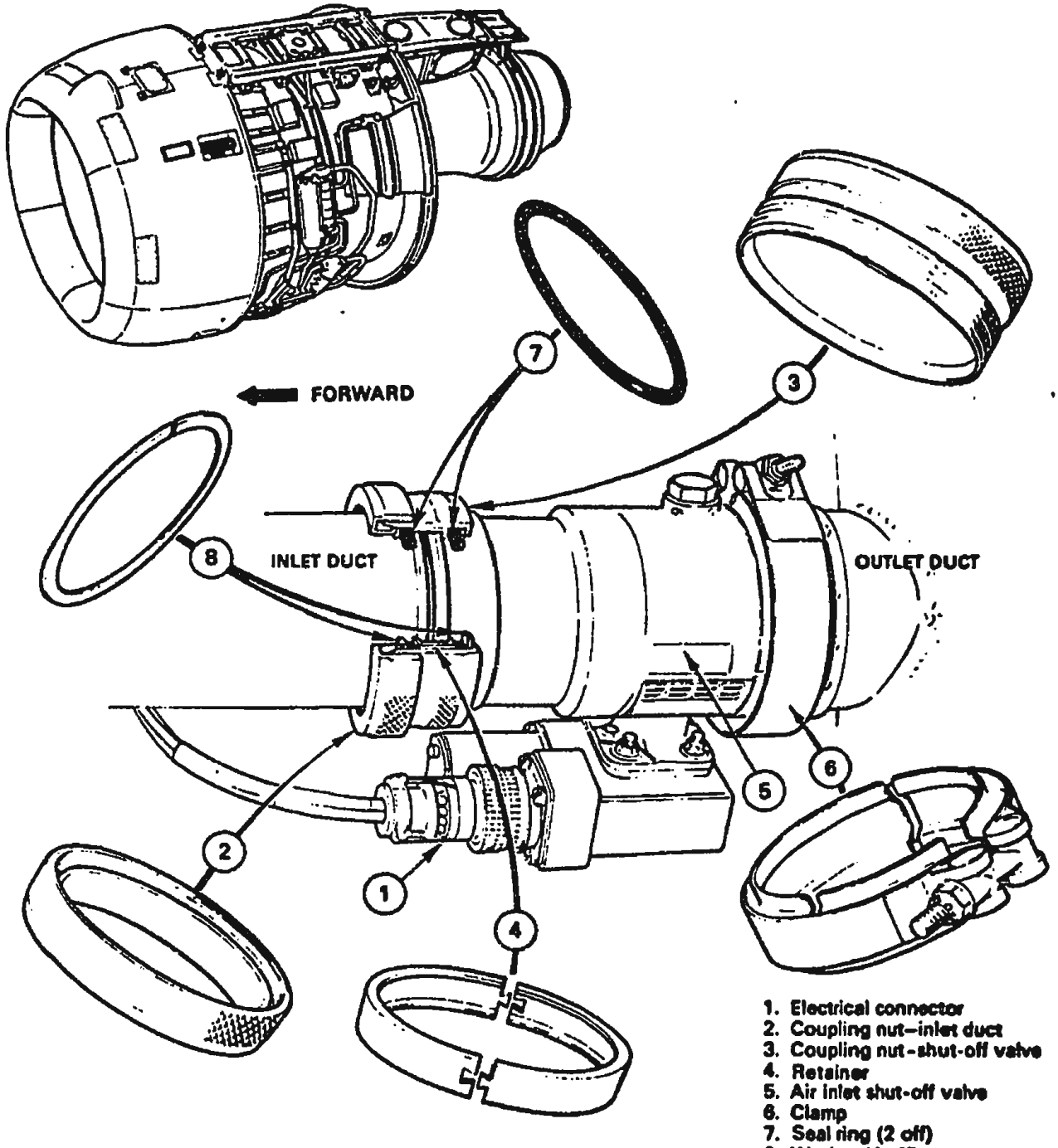
(2) Gain access to the Zone 1 ventilation inlet shutoff valve, zone 411UL or 421UL, by removing access panel 411UL or 421UL.

(3) Disconnect electrical connector at valve actuator. Install plastic caps on plug and receptacle (Ref. Fig. 401).

(4) Release coupling nuts and remove retainer (Ref. 20-21-01).

NOTE: A strap wrench can be used to loosen the nuts if they are too tight to be loosened by hand.

(5) Support valve, remove clamp (Ref. Fig. 401), and remove valve.



1. Electrical connector
2. Coupling nut–inlet duct
3. Coupling nut-shut-off valve
4. Retainer
5. Air inlet shut-off valve
6. Clamp
7. Seal ring (2 off)
8. Washer (2 off)

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Inlet Shutoff Valve Disconnects
Figure 401

EFFECTIVITY: ENGINES WITHOUT RR SB75-3594

001B

(6) If new valve is not to be installed immediately, close ends of air ducts with plastic caps. Install plastic caps on valve inlet and outlet openings.

B. Installation

(1) Verify that circuit breaker opened in Step 3A(1) is open and tagged.

(2) Remove protective caps and inspect all coupling parts for damage.

(3) Lubricate seal rings and coupling internal surfaces with silicone grease (Ref. Fig. 401).

(4) Place inlet duct coupling nut, washer and seal ring on inlet duct; place shutoff valve coupling nut, washer and seal ring on air inlet shutoff valve.

(5) Place shutoff valve to outlet duct with actuator underneath and electrical receptacle facing forward; loosely secure with clamp.

(6) Install retainer around duct and valve flanges, and mate dove-tail joints.

(7) Slide seal rings and washers against retainer; verify that seal rings are not twisted.

(8) Mate and hand-tighten coupling nuts, and lock-wire.

(9) Torque clamp 35 to 45 lb. in.

(10) Remove protective caps and connect electrical connector.

(11) Remove tag and open circuit breaker opened in Step 3A(1).

(12) Install access panel.

(13) Perform operational test to verify valve operation (Ref. 75-21-04).

AIR INLET SHUT OFF VALVE (ZONE 1), ENGINES NO. 1 AND 3 ADJUSTMENT AND TEST

1. General

This procedure provides instructions to perform a visual check to verify operation of the air inlet shutoff valve. The valve is normally in the open postion and is closed by pulling the emergency FIRE PULL handle.

2. Referenced Procedure

24-41-00 External Power/Ground Service System - Maintenance Practices

3. Adjustment/Test

A. Operational Test

(1) Turn on electrical power (Ref. 24-41-00).

(2) On pilots overhead circuit breaker panel CB1, zone 210, open and tag applicable circuit breaker FIRE EXTINGUISHER - ENG MAIN and ALTN (C10 and C11 or C14 and C15), FUEL SHUTOFF VALVE - TANK (D10 or D12), and HYD PUMP & FIREWALL SHUTOFF VALVE CONT - SYS A or SYS D (L15 or L18).

On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag applicable circuit breaker EMER & LX FEED or EMER & RX FEED (T7 or T13).

(3) On the pilots overhead panel, zone 210, pull the applicable engine FIRE PULL handle to the full aft position.

(4) Gain access to the applicable nose cowl cooling air inlet, zone 411 or 421.

(5) Using a flashlight, look into the air inlet duct and verify that the butterfly valve disk is in the closed position to prevent airflow into Zone 1.

(6) Push the applicable FIRE PULL handle to the full forward position.

(7) Look into the cooling air inlet duct and verify that the butterfly valve disk is in the open position to allow airflow into Zone 1.

(8) Remove tags and close circuit breakers opened in Step 3A(2).

(9) Turn off electrical power (Ref. 24-41-00).

AIR INLET SHUTOFF VALVE (ZONE 1), ENGINE NO. 2 REMOVAL AND INSTALLATION

1. Equipment and Materials

Strap wrench

Lock-wire, PN MS20995NC32, or equivalent

Protective caps

2. Referenced Procedures

20-21-01	Swaged Flexible Coupling - Removal and Installation
75-21-05	Air Inlet Shutoff Valve (Zone 1), Engine No. 2 - Adjustment and Test

3. Removal/Installation

A. Removal

(1) On the Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag circuit breaker ACCESS VENT AIR (N7).

(2) Remove access panel 471CR.

(3) Disconnect electrical connector at valve actuator. Install plastic caps on plug and receptacle (Ref. Fig. 401).

(4) Remove front coupling to separate forward ventilation air duct from outlet end of valve.

(5) Remove band clamp to separate valve body from support structure.

(6) Separate units of swaged flexible coupling (Ref. 20-21-01) to remove shutoff valve.

(7) If new valve is not to be installed immediately, close ends of air ducts with plastic caps. Install plastic caps on inlet and outlet openings of valve.

B. Installation

(1) Verify that circuit breaker opened in Step 3A(1) is open and tagged.

(2) Assemble swaged flexible coupling units (Ref. 20-21-01) as shown in Fig. 401, remove plastic caps, and mate aft air duct to inlet of shutoff valve.

(3) Install front coupling to mate forward air duct to valve outlet.

(4) Torque flexible coupling nuts 120 to 168 lb in., or handtight, and lock-wire.

(5) Secure valve to support structure, using band clamp.

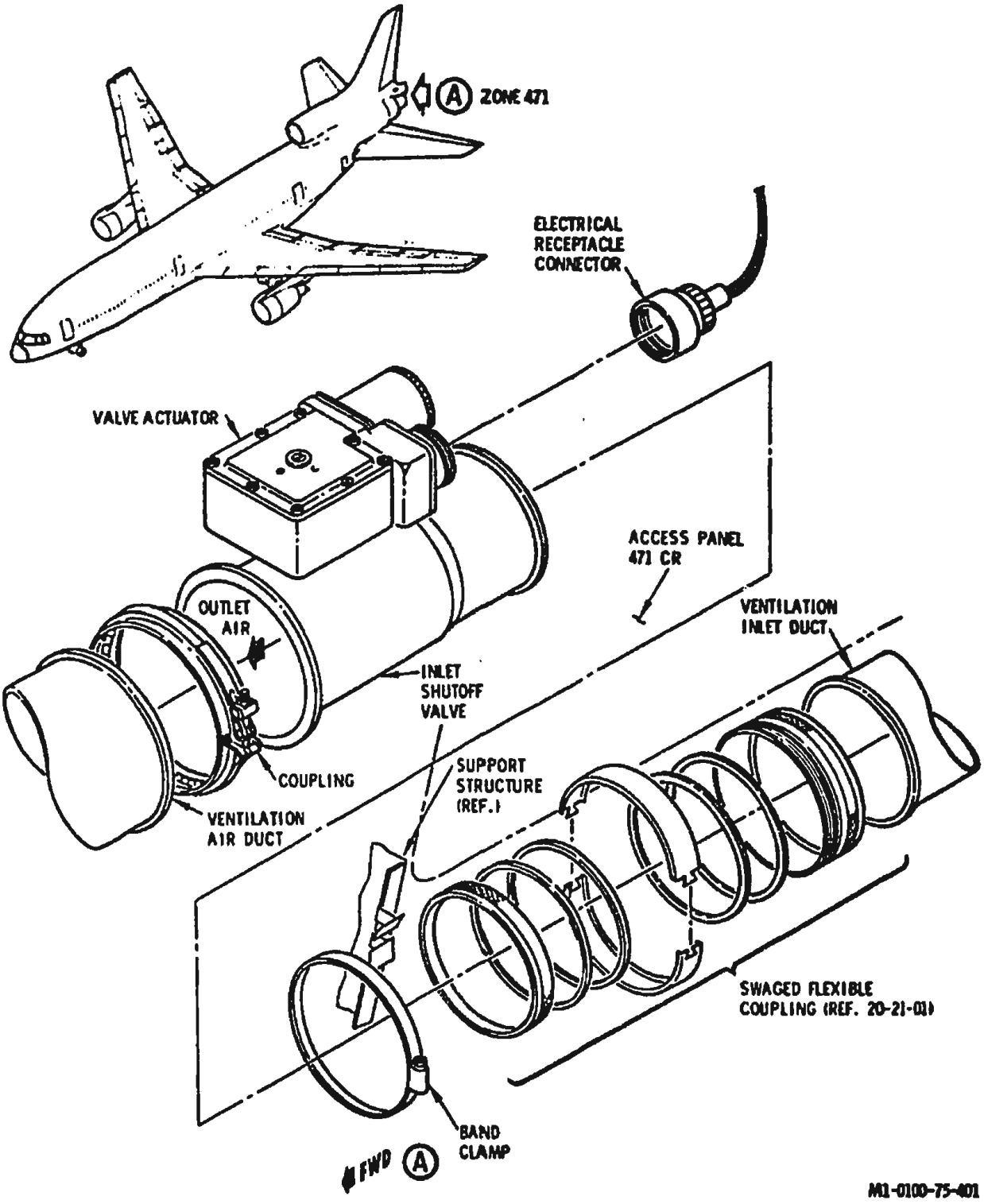
(6) Remove plastic caps and mate electrical plug and receptacle connectors.

(7) Remove tag and close circuit breaker opened in Step 3A(1).

NOTE: If valve is installed with the butterfly disk in the closed position, it will be possible to verify system operation partially when the circuit breaker on panel CB1 is closed. The visual-position indicating slot at the top of the valve actuator should move to the open position as indicated by the letter O on the actuator cover.

(8) Conduct an operational test to verify correct system operation (Ref. 75-21-05, Adjustment and Test).

(9) Close access panel.



Inlet Shutoff Valve - Removal and Installation
Figure 401

EFFECTIVITY: 001-031 WITHOUT SB26-016

001B

AIR INLET SHUTOFF VALVE (ZONE 1) ENGINE NO. 2 - ADJUSTMENT AND TEST

1. General

This procedure provides instructions to perform a visual check to verify operation of the air inlet shutoff valve. The valve is normally in the open position and is closed by pulling the emergency FIRE PULL handle.

2. Referenced Procedures

6-40-00	Exterior Access Doors and Panels
24-41-00	External Power/Ground Service System - Maintenance Practices

3. Adjustment/Test

A. Operational Test

(1) Turn on electrical power (Ref. 24-41-00).

(2) On pilots overhead circuit breaker panel CB 1, zone 210, open and tag applicable circuit breakers FIRE EXTINGUISHER - ENG MAIN and ALTN (C12 and C13), FUEL SHUTOFF VALVE - TANK (D11) and - PRI EMER (D14), and HYD PUMP & FIREWALL SHUTOFF VALVE CONT - SYS B and SYS C (L16 and L17).

On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag applicable circuit breaker SEC EMER CX FEED (T10).

(3) On the pilots overhead panel, zone 210, pull engine No. 2 FIRE PULL handle to the full aft position.

(4) Remove access panel 471 CR to gain access to air inlet shutoff valve (Ref. 6-40-00).

(5) Observe position of slot in shaft located in center of actuator cover plate to verify that the butterfly valve disk is in the closed position.

NOTE: If slot points to the letter C, the valve is closed. If slot points to the letter O, the valve is open.

(6) Push the engine No. 2 FIRE PULL handle to the full forward position.

(7) Observe position of slot in shaft to verify that the butterfly valve disk is in the open position.

(8) Install access panel 471 CR.

(9) Remove tags and close circuit breakers opened in Step 3A(2).

(10) Turn off electrical power (Ref. 24-41-00).

R

VENTILATION AIR INLET DUCTING (ZONE 1), ENGINE NO. 2 REMOVAL AND INSTALLATION

R 1. Referenced Procedures

20-21-01	Swaged Flexible Coupling - Removal and Installation
20-36-01	Single T-bolt V-band Coupling - Removal and Installation
71-12-00	Cowling, Engine No. 2 - Maintenance Practices
R PB75-425	Environmental Sealing

R 2. Removal/Installation

A. Removal

(1) Remove screws to remove flush-mounted air inlet and inlet leading edge (Ref. Fig. 401).

(2) Gain access to attaching screws for the ventilation inlet air duct through RH access fairing 472A.

(3) Remove access doors 471DL and 471CR.

(4) Remove screws retaining lower end of the ventilation inlet air duct and upper end of the ventilation air duct.

(5) Remove ventilation inlet air duct.

(6) On aircraft 001-031

without SB26-016,
release band clamp and swaged flexible coupling at inlet shutoff valve (Ref. 20-21-01).

(6) On aircraft 001-031

with SB26-016 and 032-036,
release band clamp and swaged flexible coupling at air inlet duct (Ref. 20-21-01).

(7) Remove ventilation air duct.

(8) On aircraft 001-031

without SB26-016,
remove front single T-bolt V-band coupling at inlet
R shutoff valve (Ref. 20-36-01).

(8) On aircraft 001-031

with SB26-016 and 032-036,
remove front single T-bolt V-band coupling at air inlet
R duct (Ref. 20-36-01).

(9) Open RH upper hinged cowl 434DR (Ref. 71-12-00).

(10) Support accessory compartment air duct outlet from inside engine compartment, gain access to forward ventilation duct through 471DL, and remove duct.

(11) Remove air duct outlet.

B. Installation

(1) On aircraft 001-031

without SB26-016,
install ventilation air duct by securing lower end to
R shutoff valve with swaged flexible coupling (Ref.
R 20-21-01). Secure shutoff valve to support structure with band clamp.

(1) On aircraft 001-031

with SB26-016 and 032-036,
install ventilation air duct by securing lower end to air inlet duct with swaged flexible coupling (Ref. 20-21-01). Secure air inlet duct to support structure with band clamp.

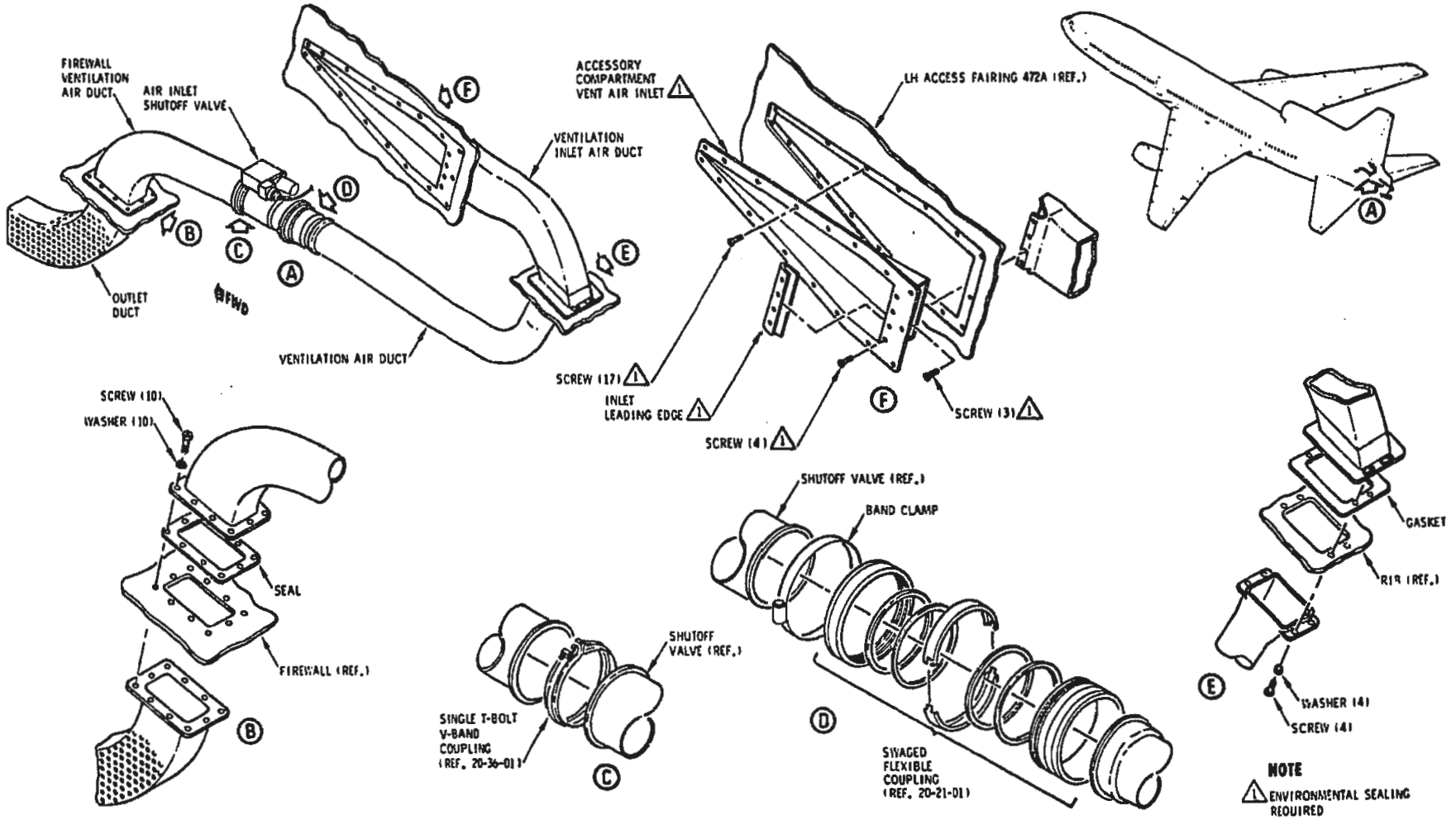
(2) Install ventilation inlet air duct and new gasket. Secure upper end of ventilation air duct with same screws used to secure lower end of inlet air duct.

(3) Prepare surface of LH access fairing 472A for installation of flush-mounted air inlet (Ref. PB75-425).

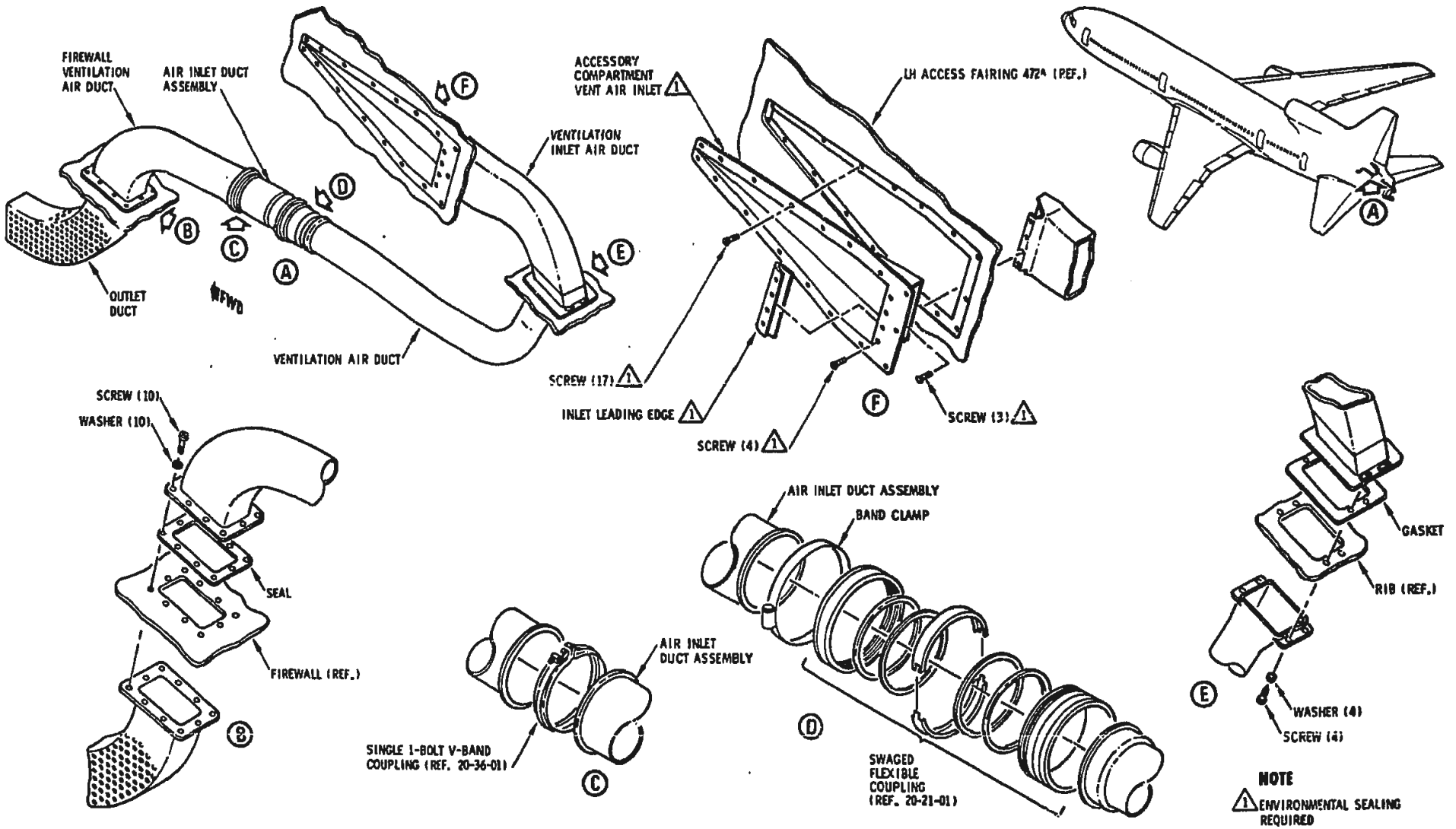
(4) Install air inlet and inlet leading edge in accordance with approved environmental sealing procedures (Ref. PB75-425).

(5) Install RH access fairing 472A.

(6) On aircraft 001-031



Ventilation Air Inlet Ducting (Engine No. 2)
Removal and Installation
Figure 401



Ventilation Air Inlet Ducting (Engine No. 2)
Removal and Installation
Figure 401

without SB26-016,
attach upper end of firewall ventilation air duct to shutoff valve, using single T-bolt V-band coupling (Ref. 20-36-01). Do not torque coupling nut at this time.

(6) On aircraft 001-031

with SB26-016 and 032-036,
attach upper end of firewall ventilation air duct to air inlet duct, using single T-bolt V-band coupling (Ref. 20-36-01). Do not torque coupling nut at this time.

(7) Install accessory compartment air duct outlet from inside engine No. 2 compartment, and match-align lower flange holes of firewall ventilation air duct with holes in horizontal firewall of center engine support structure. Install fasteners from top side.

(8) Torque single T-bolt V-band coupling (Ref. 20-36-01).

R (9) Install access doors removed in Steps 2A(2).

(10) Close RH upper hinged cowl 434DR.

INTERMEDIATE PRESSURE COMPRESSOR AIRFLOW CONTROL SYSTEM - DESCRIPTION AND OPERATION

1. General

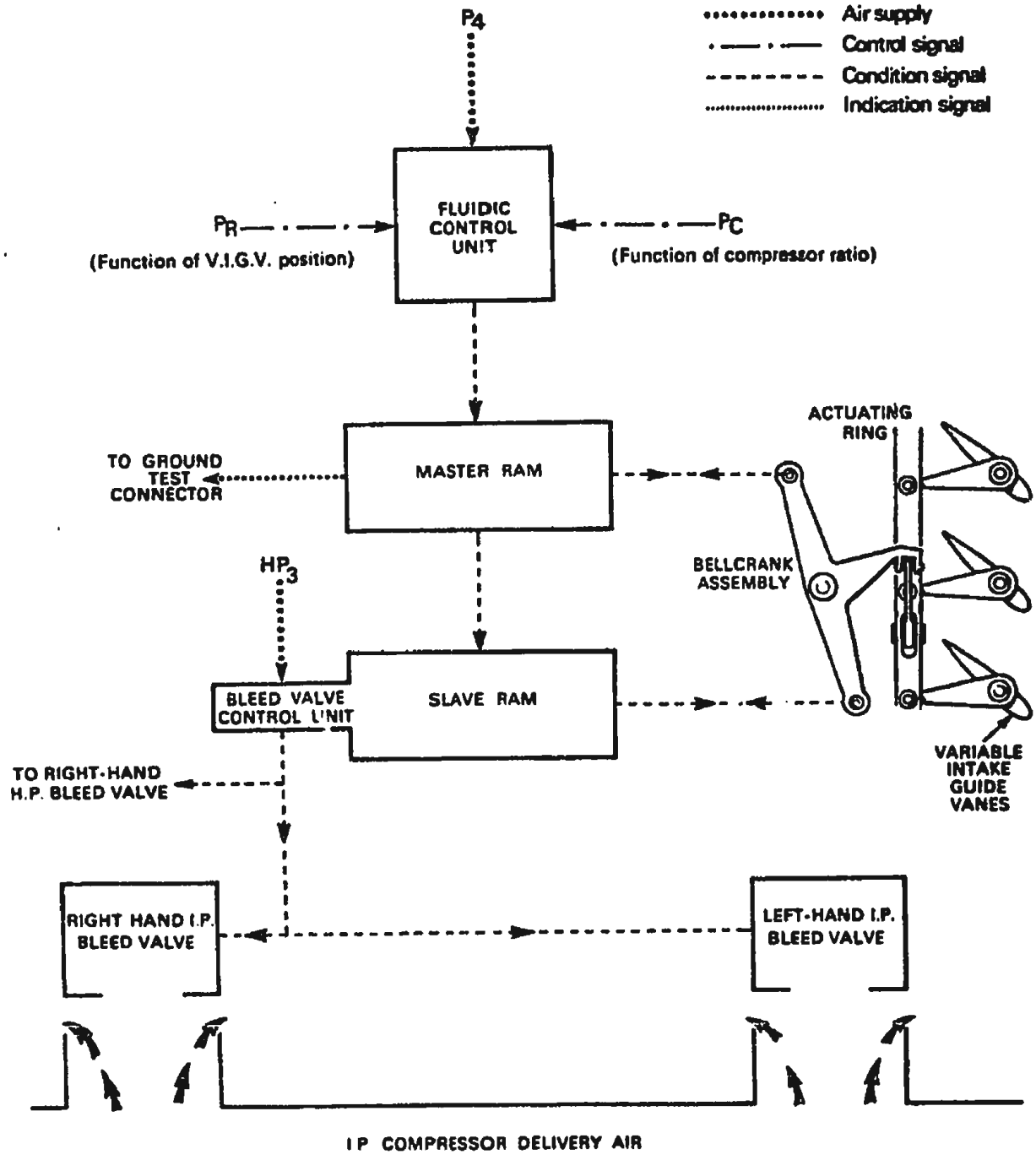
The stages of the I.P. compressor are matched to give optimum performance over the higher r.p.m. range. To maintain airflow stability at lower engine speeds variable incidence intake guide vanes and compressor air bleed valves are fitted. The guide vanes are operated, through linkage, by two pneumatic rams, the position of which also govern the operation of the bleed valves. The rams are controlled through a fluidic control unit to give a progressive variation of guide vane angle relative to a compressor ratio P4/P2. The control unit is so positioned on the engine that it senses L.P. compressor outlet pressure (PFT) instead of P2 but, at the point sensed, PFT closely relates to P2, thus providing an acceptable control parameter of P4/PFT.

The fluidic control unit basically compares a control signal PC (a function of P4/PFT) with a reference pressure signal PR (a function of guide vane position) and amplifies the difference in order to drive the rams to cancel the difference and thus provide the correct vane angle for the compressor ratio.

Fig.1 shows a simplified diagram of the system, fig.2 and 3 illustrate the units and tubes on the engine and the mechanical arrangement; fig.4 illustrates system operation diagrammatically.

2. Description

The I.P. compressor airflow control system (Ref. fig.1) basically comprises a fluidic control unit, two double-acting pneumatic rams, two bleed valves, a bellcrank assembly, an actuating ring and variable intake guide vanes. The system is located in zones 412, 422 and 432.



I.P. compressor airflow control system simplified diagram
Fig.1

The fluidic control unit is secured on the master ram (Ref. fig.2) and the two rams connect, through the bellcrank assembly and the actuating ring (Ref. fig.3), to levers attached to the outer ends of the guide vanes. Linear movement of the rams, converted to circumferential movement of the actuating ring, governs the angular position of the vanes. The rams operate in unison but in opposite direction to each other. Movement of the slave ram also operates a bleed valve control unit to control the opening and closing of the two I.P. bleed valves and the right-hand H.P. bleed valve.

The power to move the ram pistons and so operate the guide vanes is derived from H.P. compressor delivery air (P4), through the fluidic control unit.

Opening of the bleed valves is effected by air from stage 3 of the H.P. compressor (H.P.3) through the bleed valve control unit. Closing of the I.P. bleed valves is affected by I.P. compressor delivery air and the right-hand H.P. bleed valve by H.P.3 bleed air (Ref. 75-32-00).

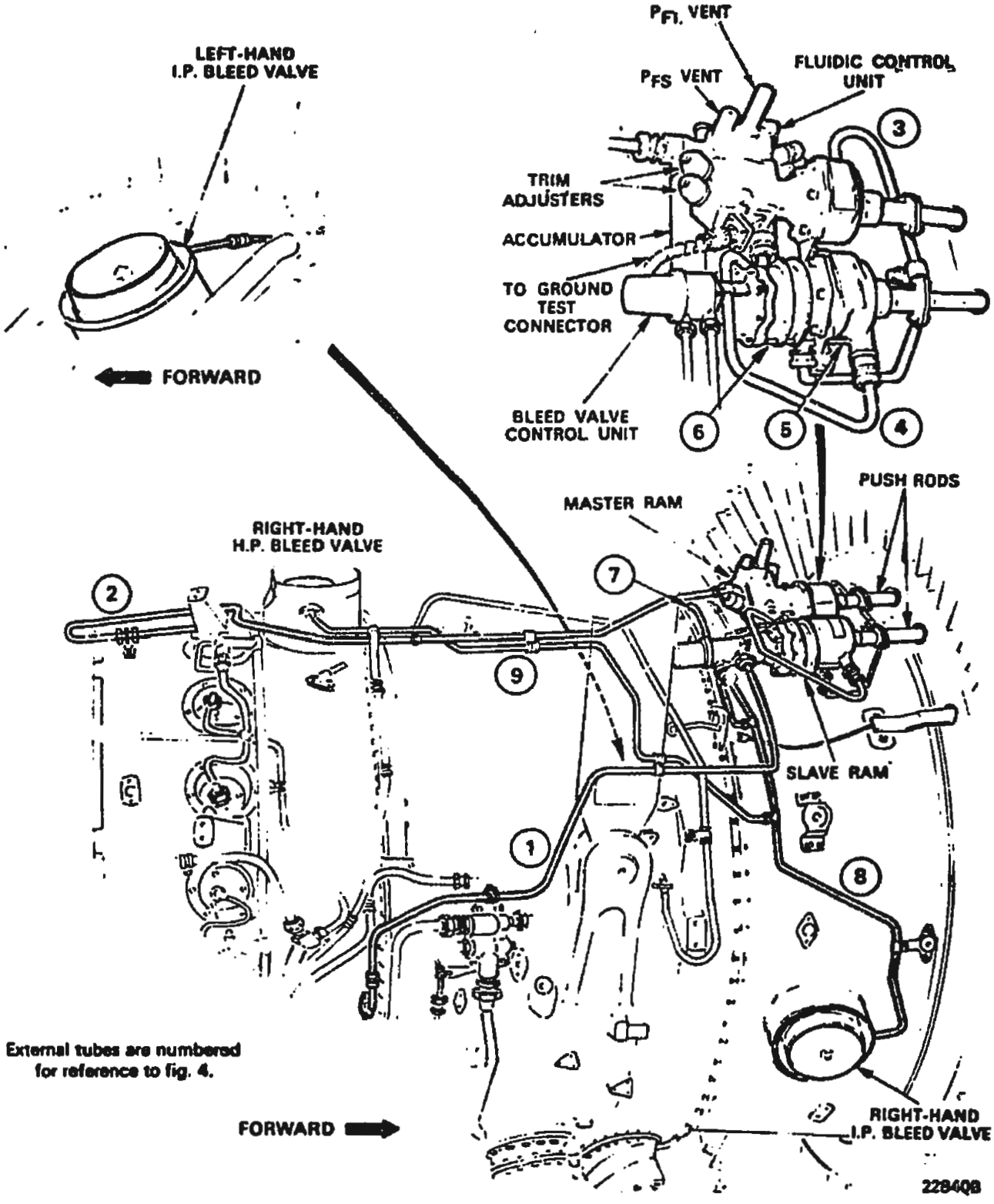
A. Intake Guide Vane Master Ram and Control Unit

The master ram and control unit (Ref. fig.2 and 4) is positioned on the right-hand side of the I.P. compressor outer case.

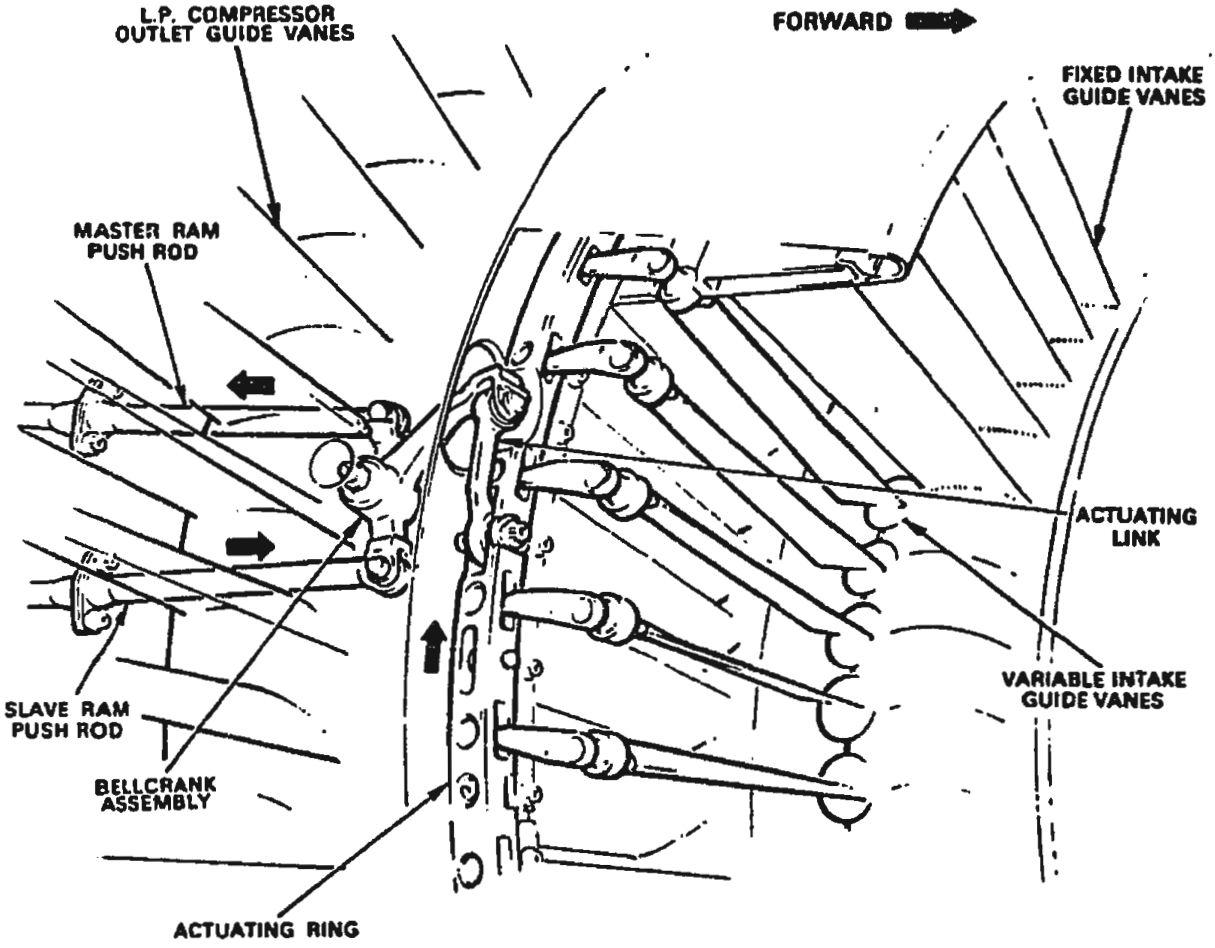
The ram consists of a piston secured to a hollow shaft and supported in a case and ram housing. The case and ram housing are secured together to form chambers each side of the piston. A connecting rod extends from the piston, through the hollow shaft, and terminates in a flanged connector for attachment to the guide vane push rod. A connecting rod (feedback mechanism), also attached to the piston, extends rearward to connect with a pivoted lever that actuates a variable orifice cam and an electrical ram position indicator.

The control unit is mounted on the ram housing and comprises a P4 supply inlet connector incorporating a filter, a fluidic element, two pressure vent tubes and an accumulator. The fluidic element comprises a jet collector and a three-stage proportional amplifier.

Drillings connect the control unit with the ram housing. Adapters provide the connectors for external tubes to the slave ram.



I.P. compressor airflow control system units and tubes
Fig.2



NOTE: Arrows indicate movement to close V.I.G.V.s towards minimum airflow position.

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I.P. compressor airflow control system mechanical arrangement
Fig.3

The fluidic element is of the proportional amplifier type which is in three stages to achieve the control signal pressure gain necessary to control the volume of amplifier outlet pressure required to actuate the rams.

The jet collector provides the control pressure (PC), that is a function of P4/PFT. The other control or reference pressure (PR) is achieved by taking a tapping of the P4 supply through orifices A and B. Orifice B is so affected by the variable orifice of the ram feedback mechanism, that PR becomes a function of ram position and therefore variable intake guide vane position.

The control signals divert the P4 air supplies to the appropriate channel of the amplifier.

The two orifices also serve as trim adjusters. By adjustment of the effective area of each orifice, it is possible to vary the angular rate of operation and also the operating datum of the guide vanes.

On units incorporating Plessey S.B. - I.G.V. - 75-2 - Introduction of fixed trim 'A' - only orifice B is adjustable.

To maintain a stable airflow under all operating conditions the system has a faster response during engine deceleration than acceleration. This is achieved by a venturi and an accumulator, in the supply to the first stage of the amplifier, the function of which is to bias the P4 supply during engine acceleration and deceleration.

The ram position indicator is connected through the engine electrical harness (Ref. 71-50-00) to the engine ground test connector on the L.P. compressor case. A ground test set, when connected to the test connector, distributes the electrical supply to the position indicator and obtains a read out of intake guide vane position.

The position indicator consists of four coils connected to form a wheatstone bridge. The proximity of a soft iron target piece operated by the feedback mechanism, varies the inductance of the coils, and hence their electrical characteristic, thus influencing the balance of the bridge and the resultant signal through the test set of intake guide vane position.

B. Intake Guide Vane Slave Ram and Bleed Valve Control Unit

The slave ram and bleed valve control unit (Ref. fig.2 and 4) is positioned on the right-hand side of the I.P. compressor outer case and is interconnected, through tubing, with the master ram.

The ram consists of two pistons secured to a common hollow shaft and supported in a case and ram housing. The case and ram housing are secured together to form separate chambers each side of the pistons. The front, and rear chambers of each piston assembly are interconnected by external transfer tubes, and adapters on the case and ram housing provide the connectors for external tubes to the master ram. A connecting rod extends from the front piston through the hollow shaft and terminates in a flanged connector for attachment to the variable intake guide vane push rod.

A bleed valve control unit housing is secured to the rear of the case assembly. A control sleeve is supported on three piston rings within the housing to form two separate chambers. An internal flange of the sleeve locates between a collar and a stop plate formed on a rearward extension from the ram hollow shaft. This feature allows the sleeve to move fractionally, independent of slave ram piston position, and thus provides a slight hysteresis between the bleed valves opening and closing points, to assist stable operation. Drillings in the control unit connect the chambers to adapters on the outside of the housing, the front adapter to the H.P.3 supply and the rear adapter to the bleed valves. Further drillings in the ram housing and the control unit end cover vent the chambers to atmosphere.

C. Intermediate Pressure Compressor Air Bleed Valve

Two bleed valves (Ref. fig.2) are positioned on the I.P. compressor outer case, one at the lower right-hand and one at the upper left-hand position. The valves are connected by an external tube to the bleed valve control unit on the slave ram and operate to bleed a proportion of the I.P. compressor delivery air into the cold stream duct.

The valves (Ref. fig.4) are identical and consist of a spring loaded piston housed in a valve body. Seal assemblies on the piston and on an inner flange of the valve body create a chamber that is connected by a drilling to an adapter, on the outside of the valve, which provides a connector for an external tube to the bleed valve control unit. The open base of the valve receives compressor delivery air and ports in the lower half of the valve body allow the delivery air to vent into the cold stream duct when the piston is moved to the open position. Expanded steel mesh around the ports prevents the ingress of foreign matter.

D. Intermediate Pressure Compressor Air Tubes

The air tubes (Ref. fig.2) are of stainless steel with nut and nipple type end connectors.

The P4 air supply tube which is in three sections, is routed from a connector on No.3 fuel spray nozzle, on the right-hand side of the combustion outer case, to the inlet connector on the control unit of the master ram. Two tubes interconnect the master and slave ram.

On engines incorporating S.B.75-2668 - P4 air tube with simplified run - the P4 supply tube is in two sections.

The H.P.3 air tube is routed from a connector on the lower right-hand side of the combustion outer case to the supply connector on the bleed valve control unit. Air to operate the bleed valves is taken from a single outlet on the control unit by a tube that is routed to the right-hand I.P. bleed valve. The tube incorporates two connectors; a tube from the upper connector is routed to the left-hand I.P. bleed valve and a tube from the lower connector is routed to the right-hand H.P. bleed valve.

The air tubes are secured to brackets on the intermediate case front flange and to bosses on the case.

3. Operation (Ref. fig.4)

A. Engine running at low power (below guide vane operating range).

The bleed valves are open and the variable inlet guide vanes are positioned against the limit stop in the minimum airflow position. Control pressure signal PC is greater than PR and the resultant pressure difference PC minus PR directs the P4 supply input to channel A of the amplifier first stage.
The outlet pressure from the amplifier first stage becomes the control pressure to the second stage to divert a further P4 supply input to the appropriate channel of the second stage. Similarly, the outlet pressure from the second stage becomes the control pressure to the third stage and is of sufficient magnitude to divert amplifier outlet pressure P01 to the front of the master ram piston and to the rear of the slave ram pistons; thus holding the guide vanes on the limit stop in the minimum airflow position.

The bleed valve control unit on the slave ram is positioned so that H.P.3 air is directed through the control sleeve to the bleed valves, assisting spring pressure to maintain the valves in the open position. A proportion of I.P. compressor delivery air and also H.P.3 bleed air is vented into the cold stream duct, through the outlet ports of the I.P. bleed valves and right-hand H.P. bleed valve.

B. Engine acceleration

As engine speed increases, PR increases at a faster rate than PC. When PR exceeds PC the resultant pressure difference PR minus PC diverts the P4 supply input to channel B of the amplifier first stage, so directing amplifier outlet pressure P02 to the rear of the master ram piston and the front of the slave ram pistons to progressively reduce guide vane angle.

Simultaneously the P4 flow to the accumulator through the venturi creates a depression that is sensed in channel X; thus giving bias to the P4 supply input, against PR, to provide a slower response rate.

Air from the opposite side of the pistons vents through the amplifier third stage to the PFS vent.

Guide vane movement, through the feedback mechanism progressively increases the variable orifice area thus reducing PR, and the pressure difference PR minus PC, until acceleration ceases (i.e. intermediate power selection when PR equals PC) or the guide vanes reach the limit stop at the maximum airflow position.

As the slave ram pistons move rearward the bleed valve control unit sleeve is moved to seal off the H.P.3 air supply and vent the chamber surrounding the bleed valve pistons to atmosphere through holes in the end cover. I.P. delivery air acting on the head of the I.P. bleed valve pistons and H.P.3 air acting on the head of the right-hand H.P. bleed valve piston, moves the pistons to close off I.P. delivery and H.P.3 air bleed (Ref. 75-32-00). The bleed valve control unit sleeve continues to move rearward relative to the slave ram piston position so delaying the point at which the bleed valves are opened on deceleration.

C. Engine deceleration

As engine speed reduces, PR decreases at a faster rate than PC. When PC exceeds PR the resultant pressure difference PC minus PR diverts the P4 supply input to channel A of the amplifier first stage, so directing amplifier outlet pressure P01 to the front of the master ram piston and the rear of the slave ram pistons to progressively increase guide vane angle.

Simultaneously with decreasing P4, the accumulator discharge flowing through the venturi creates a depression that is sensed in channel X; thus giving bias to the P4 supply input, against PR, to provide a faster response rate.

Air from the opposite side of the pistons vents through the amplifier third stage to the PFS vent.

Guide vane movement, through the feedback mechanism, progressively reduces the variable orifice area thus increasing PR and reducing the pressure difference PC minus PR until deceleration ceases (i.e. intermediate power selection when PR equals PC) or the guide vanes reach the limit stop at the minimum airflow position.

At a predetermined point the bleed valve control unit sleeve moves to permit H.P.3 air to the bleed valves to lift the pistons, and I.P. delivery and also H.P.3 bleed air vents into the cold stream duct.

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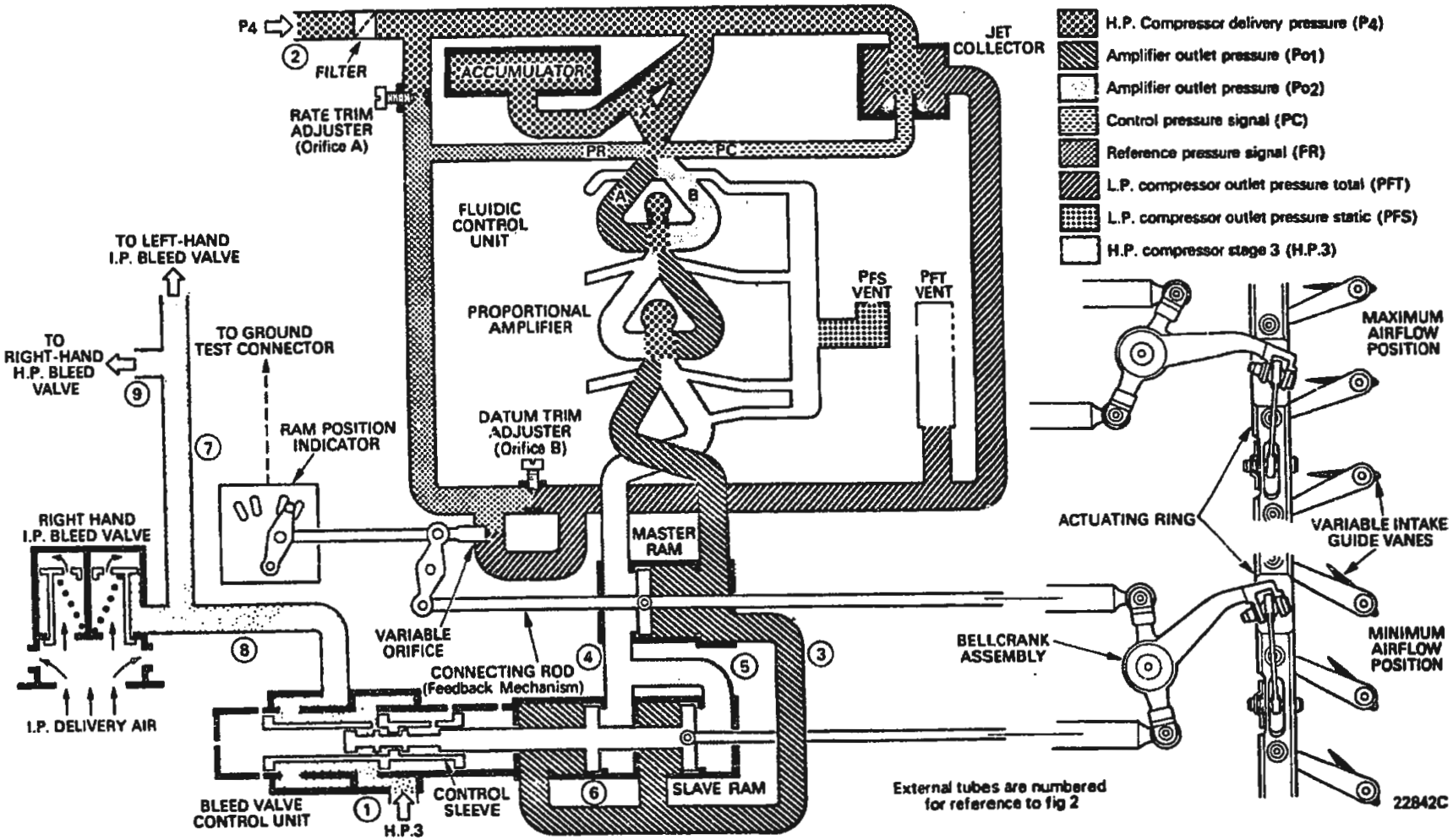


R I.P. compressor airflow control system operation
R Fig.4

I.P. COMPRESSOR AIRFLOW CONTROL SYSTEM - SERVICING

Service Bulletins referred to:

S.B.72-2927 - Splitter fairing produced in two halves.
S.B.72-3326 - Variable inlet guide vane (V.I.G.V.) actuating mechanism with low friction material.
Plessey S.B. I.G.V. 75-7 (Mod.2182) - Master ram and control - Introduction of carbon piston rings.
Plessey S.B. I.G.V. 75-8 (Mod.2183) - Slave ram - Introduction of carbon piston rings.

1. Lubricate I.P. Compressor Airflow Control System

A. Equipment required:

	CP.20309 or XUT.37594	Working platform
or	(XUT.42526	Spacer
	(XUT.42527	Side piece
	XUT.40959	Work platform, nose cowl
	289200 or C.4G.4342	Protective work mats
	UT.1066/1	Spray lubrication adapter
	Pressure vessel	Locally obtained (to dispense 1 pint in 3 1/2 minutes at 20 p.s.i.)

B. Material required:

	British Spec./Ref.	American Spec./Ref.	OMat Item No.
Penetrating oil temporary corrosion protective	Rocket WD.40 (PX.24)	Rocket WD.40 (PX.24)	1042
Cleaning fluid: (White spirit or	BS.245:1956	-	102
(Stoddard solvent or	-	ASTM.D484-52	1/5
(Varsol	-	-	-

C. WARNING: ENSURE THRUST REVERSER IS LOCKED IN FORWARD THRUST POSITION WHILE WORK IS IN PROGRESS.
Deactivate and tag thrust reverser and associated systems, and fit thrust reverser mechanical locks (Ref. 78-30-00, Servicing).

D. Lubricate V.I.G.V. Operating Mechanism (Engines incorporating S.B.72-2927)

WARNING: TO PREVENT L.P. COMPRESSOR WINDMILLING FIT HOT AND COLD STREAM OUTLET BLANKS.

CAUTION: ON ENGINES INCORPORATING S.B.72-3326, DO NOT LUBRICATE V.I.G.V. OPERATING MECHANISM.

(1) Wing engines

(a) Position work mats or work platform in nose cowl air intake ensuring red warning pennants are clearly visible from aircraft exterior.

(2) Fuselage engine

(a) Open left-hand hinged cowl 433AL (Ref.71-12-01, Servicing) and access door 431AZ.

(b) Position work mats in air intake ensuring red warning pennants are clearly visible from aircraft exterior.

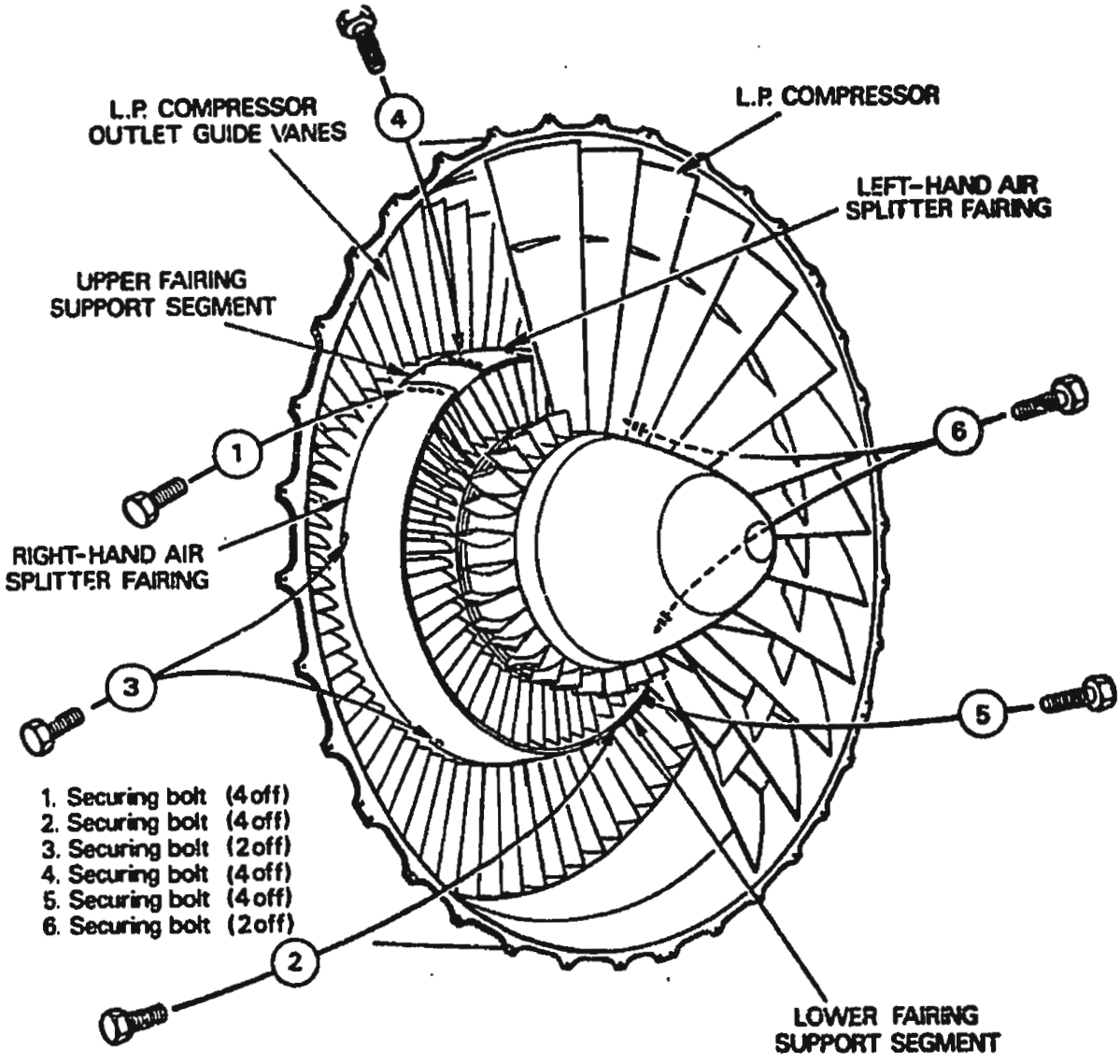
(3) Enter air intake and gaining access through L.P. compressor blade spacing, refer to fig.301 and remove bolts (1) and (2).

(4) Remove bolts (3) then move right-hand air splitter fairing forwards and carefully lower onto L.P. compressor inner case.

(5) Remove bolts (4) and (5).

(6) Remove bolts (6) then move left-hand air splitter fairing forwards and carefully lower onto L.P. compressor inner case.

(7) Gaining access between each pair of L.P. compressor blades, clean V.I.G.V. operating mechanism using cleaning fluid.



Air splitter fairing removal/installation (S.B.72-2927)
Fig.301

(8) Gaining access between each pair of L.P. compressor blades, lubricate V.I.G.V. operating mechanism including portion covered by upper and lower fairing support segments (Ref. fig.301) using WD.40 aerosol dispenser.

(9) Fit left-hand air splitter fairing, ensuring correct location on front bearing housing, inner platform of L.P. compressor outlet guide vane (O.G.V.) assembly and upper and lower fairing support segments then fit and secure bolts (4) and (5).

(10) Fit and secure bolts (6).

(11) Fit right-hand air splitter fairing, ensuring correct location on front bearing housing, inner platform of L.P. compressor O.G.V. assembly and upper and lower fairing support segments then fit and secure bolts (1) and (2).

(12) Fit and secure bolts (3).

(13) Wing engines

(a) Remove work mats or work platform from air intake.

(14) Fuselage engine

(a) Remove work mats from air intake.

(b) Close access door 431AZ and left-hand hinged cowl 433AL (Ref. 71-12-01, Servicing).

E. Lubricate V.I.G.V. Operating Mechanism (Engines not incorporating S.B.72-2927)

WARNING: TO PREVENT L.P. COMPRESSOR WINDMILLING FIT HOT AND COLD STREAM OUTLET BLANKS.

CAUTION: ON ENGINES INCORPORATING S.B.72-3326, DO NOT LUBRICATE V.I.G.V. OPERATING MECHANISM.

(1) Wing engines

(a) Position work mats or work platform in nose cowl air intake ensuring red warning pennants are clearly visible from aircraft exterior.

(2) Fuselage engine

(a) Open left-hand hinged cowl 433AL (Ref. 71-12-01, Servicing) and access door 431AZ.

(b) Position work mats in air intake ensuring red warning pennants are clearly visible from aircraft exterior.

(3) Fill a suitable pressure vessel with the required amount of WD.40.

(4) Connect adapter UT.1066/1 to hose of pressure vessel then pressurize vessel to 20 p.s.i.

(5) Enter air intake and gaining access through L.P. compressor blade spacing, remove one bolt securing air splitter fairing to L.P. compressor O.G.V. assembly.

(6) Enter adapter UT.1066/1 through securing bolt hole and lubricate V.I.G.V. operating mechanism.

(7) Remove UT.1066/1 from bolt hole then fit and secure bolt.

(8) Repeat operations (5) through (7) at five remaining securing bolt positions in air splitter fairing.

(9) Wing engines

(a) Remove work mats or work platform from air intake.

(10) Fuselage engine

(a) Remove work mats from air intake.

(b) Close access door 431AZ and left-hand hinged cowl 433AL (Ref. 71-12-01, Servicing).

CR F. Lubricate Master and Slave Rams DELETED

INTERMEDIATE PRESSURE COMPRESSOR AIRFLOW CONTROL SYSTEM - ADJUSTMENT/TEST

Service bulletins referred to:

Plessey S.B. I.G.V.75-7 (Mod.2182) - Master ram and control - Introduction of carbon piston rings.
Plessey S.B. I.G.V.75-8 (Mod.2183) - Slave ram - Introduction of carbon piston rings.
Plessey S.B. I.G.V.75-8 (Mod.2535) - Slave ram - Introduction of composite piston ring seals.
S.B.72-3326 - Variable inlet guide vane (V.I.G.V.) actuating mechanism with low friction material.

The adjustment procedures for the I.P. Compressor Airflow Control System are contained in 71-00-00, Adjustment/Test.

The test procedures are described in this section and are as follows:

	Paragraph	Procedure	Page
CR	1.	Adjust I.P. Compressor Airflow Control System	501
	2.	Test Loading of I.P. Compressor Airflow Control System.	504
	A.	Test Static Loading of System (Method 1).	504
	B.	Ground Run Test of System Loading (Method 2).	513

CR 1. Adjust I.P. Compressor Airflow Control System

CR A. Adjust IP compressor airflow control system - SB 75-2008 not incorporated (Plessey MOD2101)

CR WARNING: ENSURE THRUST REVERSER SYSTEM IS LOCKED IN FORWARD THRUST POSITION WHILE WORK IS IN PROGRESS.

CR (1) Lock thrust reverser system in forward thrust position (Ref.78-30-00).

CR (2) On pilots overhead circuit breaker panel CB1, zone 210, open and tag applicable circuit breaker ENGINE START CONT (E13, E14, E15).

CR (3) Position splitter area access work platform in cold stream duct.

CR (4) Enter cold stream duct and open pressure relief door in compressor section right-hand front gas generator fairing (Ref.72-03-00).

CR (5) Adjust VIGV datum setting (trim 'B').

CR (a) Fit adjusting tool (Ref.71-00-00) Fig.530 to datum adjuster.
Turn adjuster clockwise to increase N2; counterclockwise to decrease N2. One click alters N2 by 0.5 to 0.7 percent at any VIGV angle. On master ram units incorporating Plessey SB IGV 75-13 (Mod. 2178) Introduction of Improved Trim B, one click alters N2 by approximately 0.35 per cent at any VIGV angle.

CR CAUTION: ON UNITS NOT INCORPORATING PLESSEY S.B.75-28-2320, ADJUSTMENT OF THE MASTER RAM TRIM 'B' MUST BE LIMITED TO 4 CLICKS CLOCKWISE OR ANTI-CLOCKWISE FROM THE RIG DATUM SETTING MARK. THEREFORE IF THE ARROW ON THE SQUARE ADJUSTER IS NOT POINTING TO AND ALIGNED WITH THE RIG DATUM SETTING MARK, THE NUMBER OF CLICKS TO BRING THE ARROW AND SETTING MARK INTO ALIGNMENT MUST BE DETERMINED AND TAKEN INTO ACCOUNT BEFORE ANY FURTHER ADJUSTMENT IS MADE. IF SATISFACTORY SCHEDULING CANNOT BE OBTAINED WITHIN THIS ADJUSTMENT RANGE, THE MASTER RAM MUST BE CHANGED.

CR (6) DELETED

CR (7) Close pressure relief door in compressor section right-hand front gas generator fairing (Ref.72-03-00).

CR (8) Remove working platform from cold stream duct.

CR (9) Unlock thrust reverser system (Ref.78-30-00).

CR (10) Remove tags and close circuit breakers opened in Step (2).

CR B. Adjust IP Compressor Airflow Control System - SB 75-2008 CR Incorporated (Plessey MOD 2101)

CR WARNING: ENSURE THRUST REVERSER SYSTEM IS LOCKED IN CR FORWARD THRUST POSITION WHILE WORK IS IN PROGRESS.

CR (1) Lock thrust reverser system in forward-thrust position CR (Ref.78-30-00).

CR (2) On pilots overhead circuit breaker panel CB1, zone 210, CR open and tag applicable circuit breaker ENGINE START CR CONT (E13, E14, or E15).

CR (3) Position splitter area access work platform in cold CR stream duct.

CR (4) Enter cold stream duct and open pressure relief door in CR compressor section right-hand front gas generator CR fairing (Ref.72-03-00).

CR (5) Adjust VIGV datum setting (Trim 'B').

CR (a) Fit adjusting tool (Ref.71-00-00) Fig.530 to CR datum adjuster. Turn adjuster clockwise to CR increase N2; counterclockwise to decrease N2. CR One click alters N2 by 0.5 to 0.7 per cent at CR any VIGV angle. On master ram units incorporating CR Plessey SB IGV 75-13 (Mod. 2178) Introduction of CR Improved Trim B, one clock alters N2 by CR approximately 0.35 per cent at any VIGV angle.

CR CAUTION: ADJUSTMENT OF THE MASTER RAM TRIM 'B' MUST BE CR LIMITED TO 2 CLICKS FOR PRE PLESSEY S.B. IGV 75-13 CR MOD 2178 AND 4 CLICKS FOR POST PLESSEY S.B. IGV CR 75-13 MOD 2178. ADJUSTMENT IS CLOCKWISE OR CR ANTI-CLOCKWISE FROM RIG DATUM SETTING MARK CR (REF. FIG.503 AND 504). IF SATISFACTORY CR SCHEDULING CANNOT BE OBTAINED WITHIN THIS RANGE, CR THE MASTER RAM MUST BE CHANGED.

CR (6) Close pressure relief door in compressor section CR right-hand front gas generator fairing (Ref.72-03-00).

CR (7) Remove working platform from cold stream duct.

CR (8) Unlock thrust reverser system (Ref.78-30-00).

CR (9) Remove tags and close circuit breakers opened in CR Step (2).

2. Test Loading of I.P. Compressor Airflow Control System

There are two methods of testing the system load

Method 1. Is a static test and should be used whenever possible.

Method 2. Is a part power acceleration test and is provided as a means of testing engine No.2 (where accessibility is difficult).

A. Test Static Loading of System (Method 1)

(1) Equipment required:

CP.20309 or XUT.37594	Working platform
or (XUT.42526	Spacer
(XUT.42527	Side piece
UT.1009	Load tool
HU.21580	Load gauge
HU.21239	Opening tool

(2) WARNING: ENSURE THRUST REVERSER IS LOCKED IN FORWARD THRUST POSITION WHILE WORK IS IN PROGRESS
Deactivate and tag thrust reverser and associated systems, and fit thrust reverser mechanical locks (Ref. 78-30-00, Servicing).

(3) Position working platform in cold stream duct.

(4) Refer fig.502 enter cold stream duct and insert tool HU.21239 in slot between catch plunger and striker plate. Lever tool rearward to open pressure relief door in compressor section R.H. front gas generator fairing (Ref. 72-03-00).

(5) Fit load tool to body end of load gauge.

(6) Refer to fig.501, locate load tool over head of bolt securing push rod to slave ram (Ref. 'A', fig.501).

(7) Pull on load gauge and record load at which push rod starts to move. Continue pulling until push rod stops moving then remove load tool. During this operation check master ram travel, which should be 1.10in. (27,9 mm.) approximately.

(8) Locate load tool over head of bolt securing push rod to master ram (Ref. 'B', fig.501).

(9) Pull on load gauge and record load at which push rod starts to move. Continue pulling until push rod stops moving then remove load tool.

(10) If loads recorded in operations (7) and (9) are less than 60 lbf. (266,8 N.) proceed to and effect operations (14) through (16).

If loads recorded in operations (7) and/or (9) are greater than 60 lbf. (266,8 N.) but less than 70 lbf. (311,3 N.) effect tests detailed in operations (11), (12) and (13), and if loads recorded in operations (11), (12) and (13) are within limits proceed to and effect operations (14) through (16).

If loads recorded in operations (7) and/or (9) are greater than 70 lbf. (311,3 N.) effect tests detailed in operations (11), (12) and (13). If loads recorded in operations (11), (12) and (13) are within limits and sum of the three loads is less than 70 lbf. (311,3 N.) proceed to and effect operations (14) through (16).

If loads recorded in operations (11), (12) and (13) are within limits, but sum of the three loads exceeds 70 lbf. (311,3 N.), lubricate (Ref. Servicing) operating mechanism and master ram and on slave ram units without Plessey S.B.I.G.V.75-8 (Mod.2183) or S.B.I.G.V.75-62 (Mod.2535) lubricate slave ram, (Ref.Servicing) then repeat operations (6) through (10)

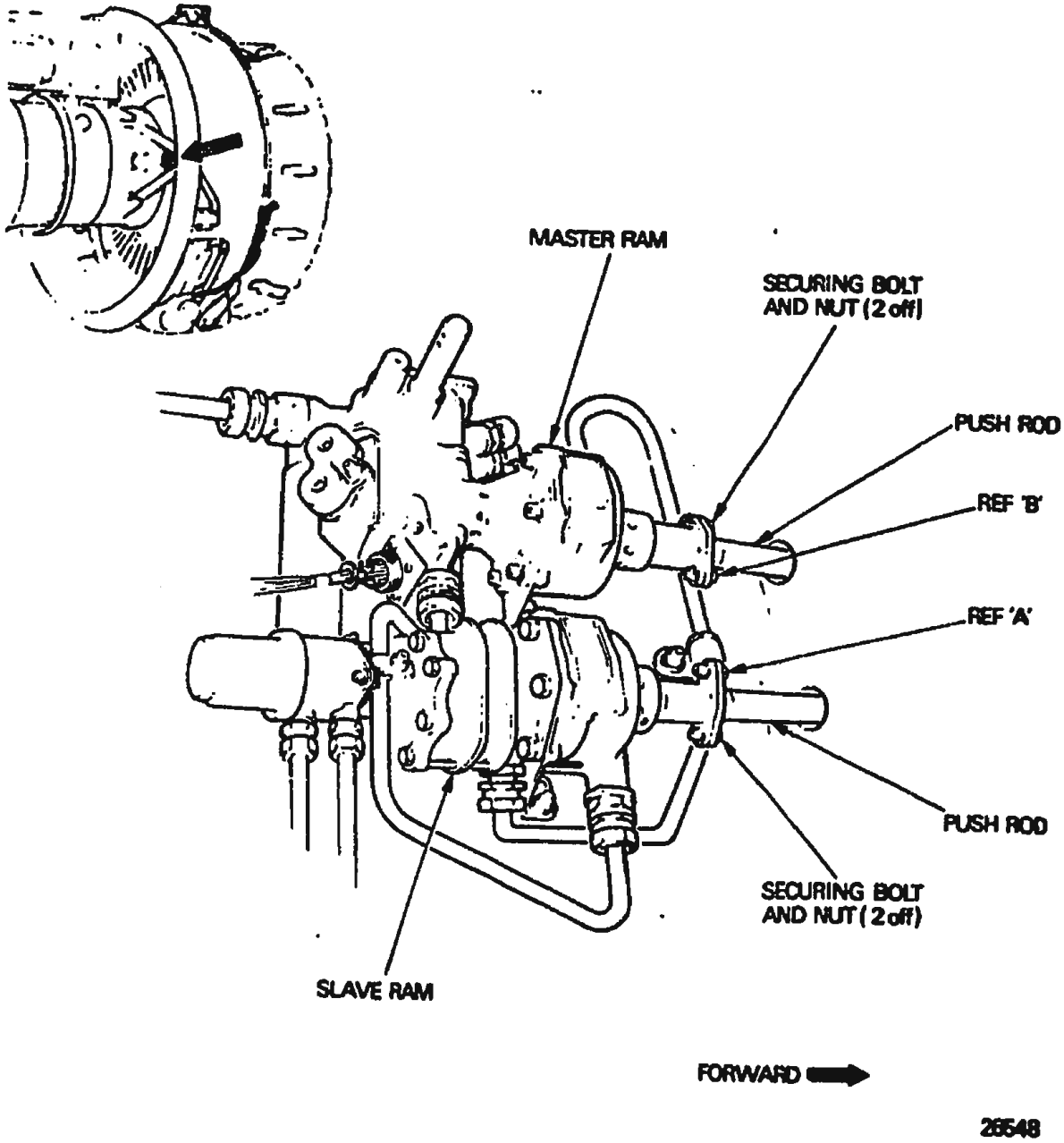
(11) Test static loading of V.I.G.V. operating mechanism

(a) Remove compressor section right-hand front gas generator fairing (Ref. 72-03-00, Removal/ Installation).

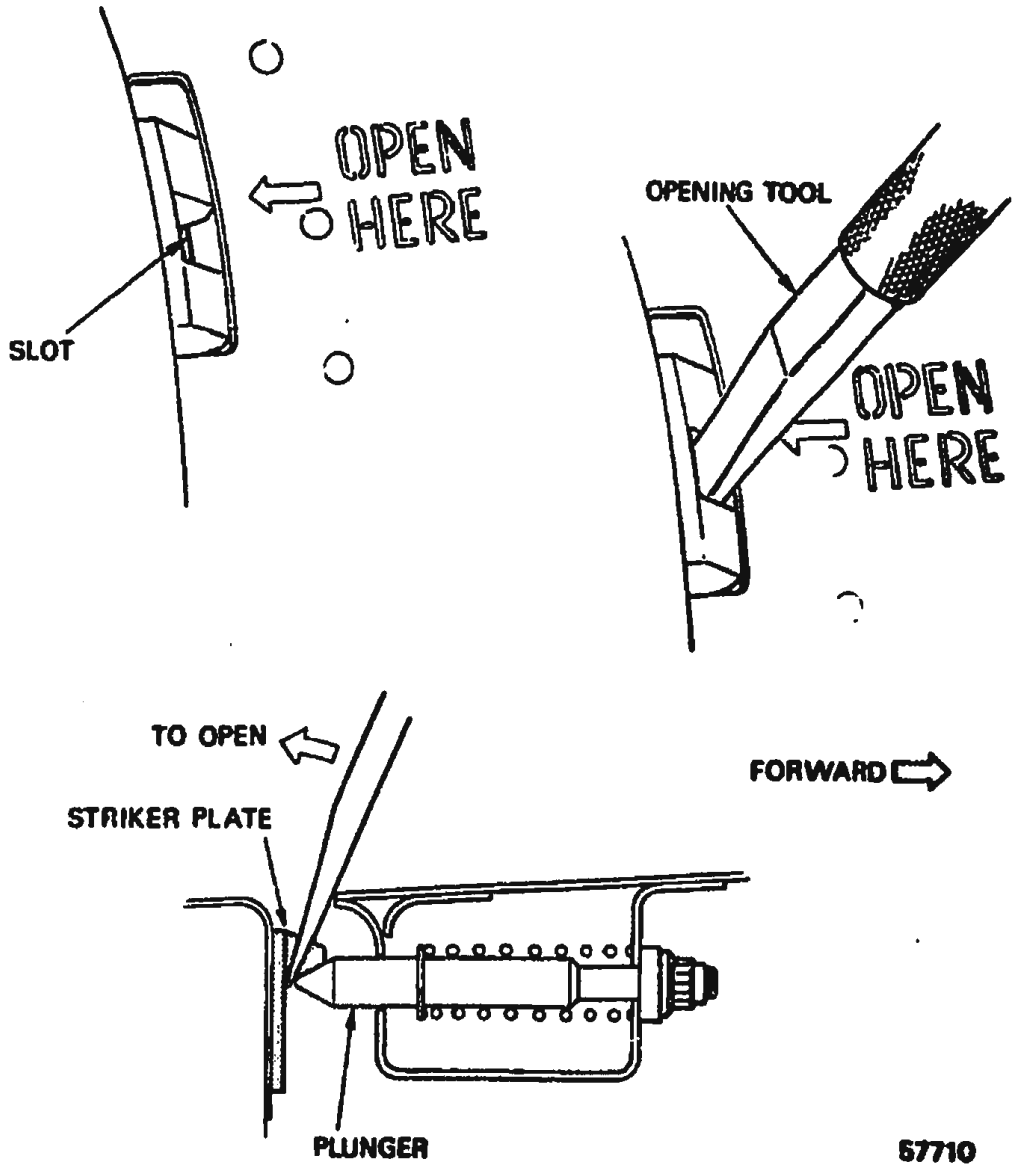
(b) Fit load tool to body end of load gauge.

(c) Refer to fig.501, remove nuts and bolts securing push rods to master and slave rams then manually separate push rods from rams.

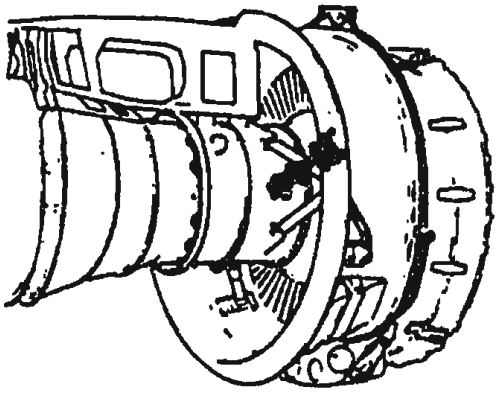
(d) Manually retract slave ram.



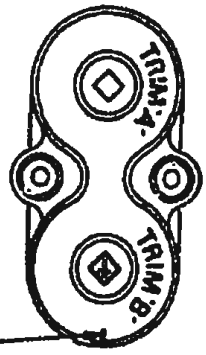
I.P. compressor airflow control system static load test
Fig.501

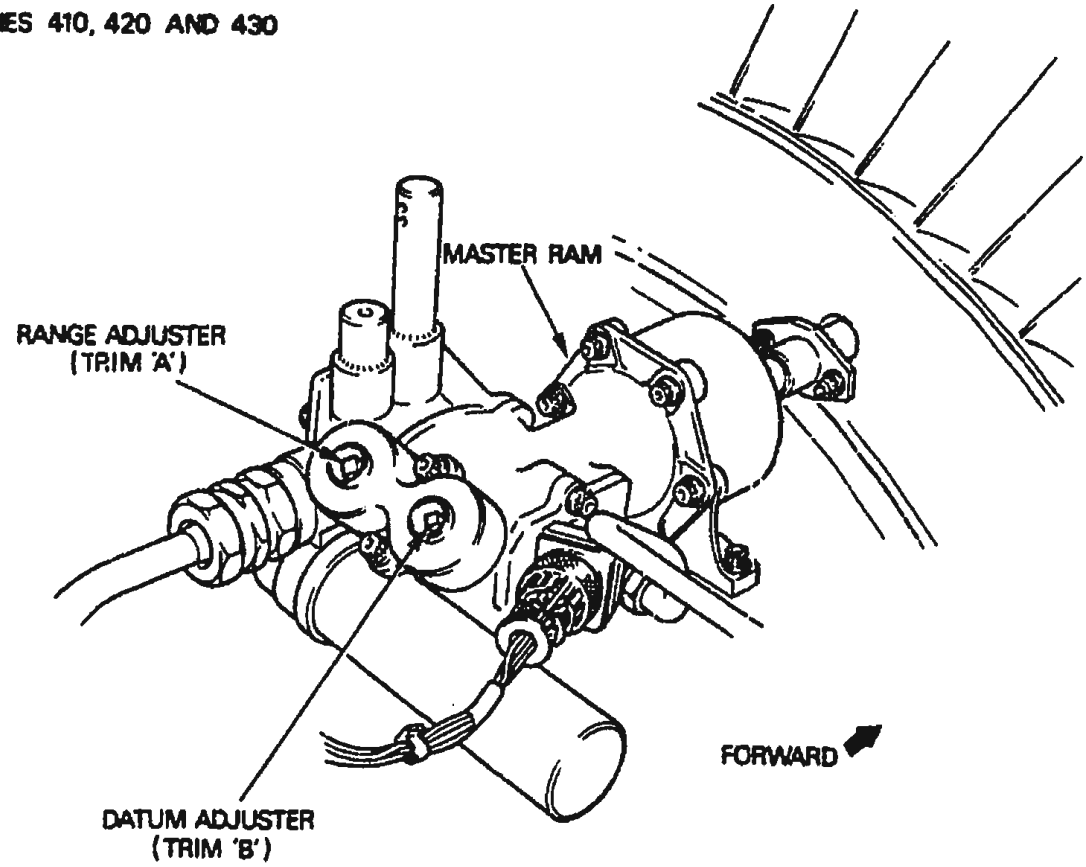


Opening pressure relief door
Fig.502



ZONES 410, 420 AND 430





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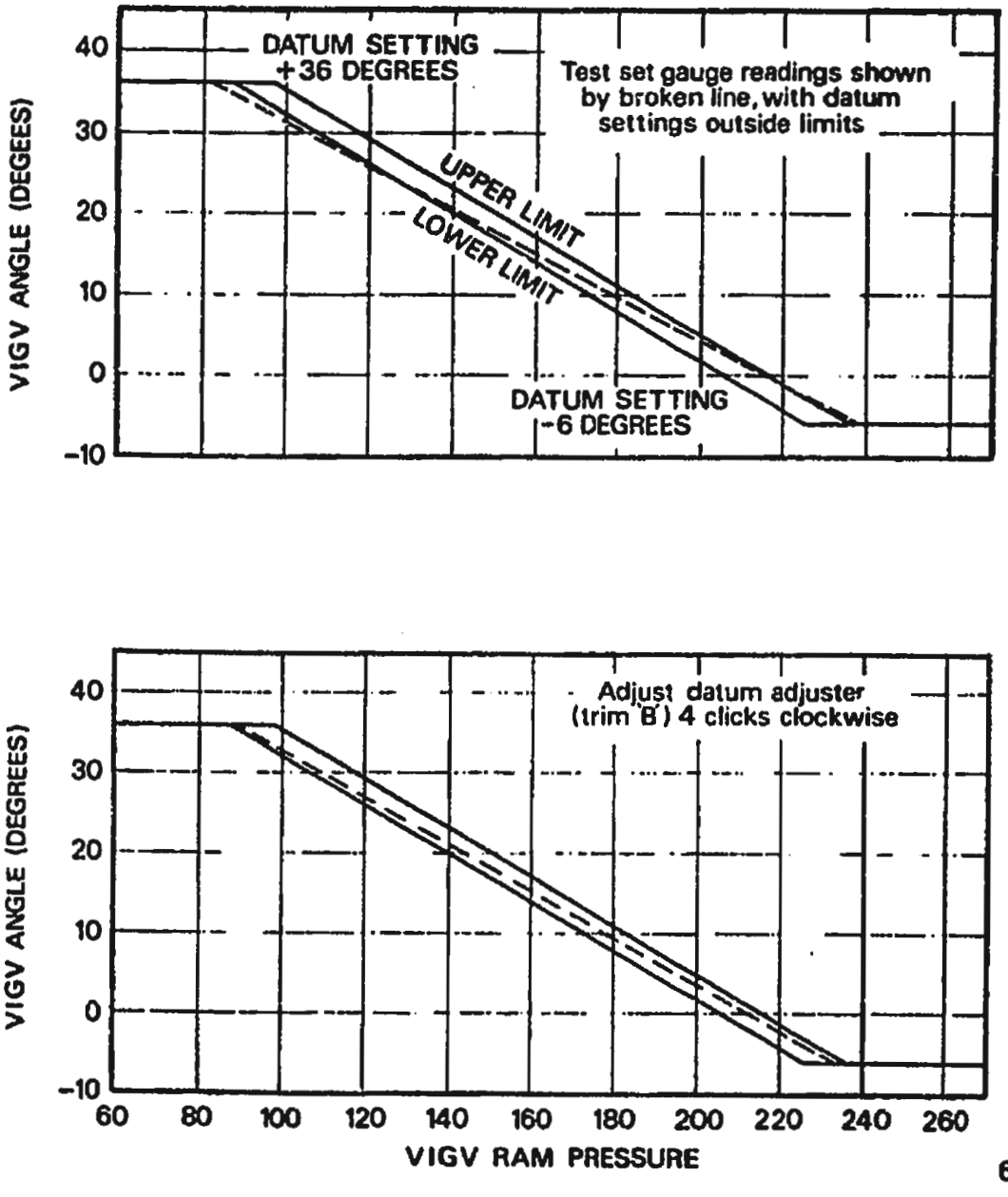
CR I.P. compressor airflow control system adjusters
CR Fig.503



CR CR Variable inlet guide vanes adjustment example effect
Fig.504

(e) Locate load tool on forward face of slave ram push rod mating flange.

(f) Pull on load gauge and record load at which push rod starts to move. Continue pulling until push rod stops moving then remove load tool.

(g) Locate load tool on forward face of master ram push rod mating flange.

(h) Pull on load gauge and record load at which push rod starts to move. Continue pulling until push rod stops moving then remove load tool.

(j) Check that loads recorded in operations (f) and (h) are less than 30 lbf. (133,4 N.).

(k) CAUTION: ON ENGINES WITH S.B.72-3326, DO NOT LUBRICATE V.I.G.V. OPERATING MECHANISM.
On engines with S.B.72-3326, if recorded loads are greater than 30 lbf. (133,4 N.) clean V.I.G.V. inner pivot bushes (Ref. Cleaning/Painting), then repeat operations (e) through (j). If cleaning does not reduce load below 30 lbf. (133,4 N.) reject engine for further investigation.

(m) On engines without S.B.72-3326, if recorded loads are greater than 30 lbf. (133,4 N.), lubricate V.I.G.V. operating mechanism (Ref. Servicing) and/or clean V.I.G.V. inner pivot bushes (Ref. Cleaning/Painting), then repeat operations (e) through (j). If lubrication and/or cleaning does not reduce load below 30 lbf. (133,4 N.), reject engine for further investigation.

(n) Manually extend slave ram to mate with push rod flange.

(p) Fit and secure bolts and nuts securing push rods to master and slave rams.

(12) Test static loading of master ram

(a) Refer to fig.501, remove nuts and bolts securing push rod to master ram then manually separate push rod from ram.

(b) Manually move V.I.G.V. operating mechanism, by pushing on master ram push rod until push rod stops moving (vanes fully open).

(c) Fit load tool to plunger end of load gauge then place tool against rear face of master ram mating flange.

(d) Push on load gauge and record load at which ram starts to move. Continue pushing until master ram stops moving then remove load tool.

(e) Check that load recorded in operation (d) is less than 20 lbf. (88,9 N.).

(f) On master ram units with Plessey S.B. I.G.V. 75-7 (Mod.2182), if recorded load is greater than 20 lbf. (88,9 N.) reject engine for further investigation.

On master ram units without Plessey S.B. I.G.V. 75-7 (Mod.2182), if recorded load is greater than 20 lbf. (88,9 N.), lubricate master ram (Ref. Servicing), then repeat operations (b) through (e). If lubrication does not reduce load below 20 lbf. (88,9 N.), reject engine for further investigation.

(g) Manually move V.I.G.V. operating mechanism, by pushing on slave ram push rod until push rod stops moving (vanes fully closed).

(h) Fit and secure bolts and nuts securing push rod to master ram.

(13) Test static loading of slave ram

(a) Refer to fig.501, remove nuts and bolts securing push rod to slave ram then manually separate ram from push rod.

(b) Manually retract slave ram.

(c) Fit load tool to plunger end of load gauge then place tool against rear face of slave ram mating flange.

(d) Push on load gauge and record load at which ram starts to move. Continue pushing until slave ram stops moving then remove load tool.

(e) Check that load recorded in operation (d) is less than 25 lbf. (111,2 N.).

(f) On slave ram units with Plessey S.B. I.G.V. 75-8 (Mod.2183) or S.B. I.G.V.75-62 (Mod.2535) if recorded load is greater than 25 lbf. (111,2 N.), reject engine for further investigation.

On slave ram units without Plessey S.B.I.G.V. 75-8 (Mod.2183) or S.B.I.G.V.75-62 (Mod.2535), if recorded load is greater than 25 lbf. (111,2 N.), lubricate slave ram (Ref. Servicing), then repeat operations (c) through (f). If lubrication does not reduce load below 25 lbf. (111,2 N.), reject engine for further investigation.

(g) Fit and secure bolts and nuts securing push rod to slave ram.

(h) Install compressor section right-hand front gas generator fairing (Ref. 72-03-00, Removal/ Installation).

(14) Close pressure relief door in compressor section right-hand front gas generator fairing, (Ref. 72-03-00, Removal/Installation).

(15) Remove working platform from cold stream duct.

(16) Unlock and reactivate thrust reverser and associated systems (Ref. 78-30-00, Servicing).

B. Ground Run Test of System Loading (Method 2)

(1) Start engine (Ref. 71-00-00, Maintenance Practices) and run at ground idle.

(2) Advance throttle lever slowly to achieve 1.35 E.P.R., record N2 and mark throttle quadrant plate in line with throttle lever.

(3) Close throttle to ground idle.

(4) Advance throttle lever in 0.5 seconds (approximately) to mark on throttle quadrant plate and record any N2 overswing.

(5) If overswing is greater than 2% N2, stop the engine (Ref. 71-00-00, Maintenance Practices) and test static loading of I.P. compressor airflow control system (Method 1).

INTERMEDIATE PRESSURE COMPRESSOR AIRFLOW CONTROL SYSTEM - CLEANING/PAINTING

1. Clean V.I.G.V. Inner Pivot Bushes

WARNING: TO PREVENT L.P. COMPRESSOR WINDMILLING FIT HOT AND COLD STREAM OUTLET BLANKS.

Referenced Procedures:

71-12-01	L.H. and R.H. Lower Hinged Cowls - Servicing
72-03-00	Gas Generator Fairings - Removal/Installation
78-30-00	Thrust Reverser - Servicing

A. Equipment required:

CP.20309 or XUT.37594	Working platform
or (XUT.42526	Spacer
(XUT.42527	Side piece
XUT.40959	Work platform, nose cowl
289200 or C.4G.4342	Protective work mats
R HU.21239	Opening tool

B. Material required:

	British Spec./Ref.	American Spec./Ref.	OMat Item No.
Cleaning fluid:			
(White spirit or	BS.245:1956	-	102
(Stoddard solvent or	-	ASTM D484-52	1/5
(Varsol	-	-	-

C. WARNING: ENSURE THRUST REVERSER IS LOCKED IN FORWARD THRUST POSITION WHILE WORK IS IN PROGRESS.
Deactivate and tag thrust reverser and associated systems, and fit thrust reverser mechanical locks (Ref. 78-30-00).

D. Engines No.1 and 3

(1) Position work mats or work platform in nose cowl air intake ensuring red warning pennants are clearly visible from aircraft exterior.

E. Engine No.2

(1) Open L.H. hinged cowl 433AL (Ref. 71-12-01) and access door 431AZ.

(2) Position work mats in air intake ensuring red warning pennants are clearly visible from aircraft exterior.

F. Position working platform in cold stream duct.

R G. Refer fig.702 enter cold stream duct and insert tool
R HU.21239 in slot between catch plunger and striker plate.
R Lever tool rearward to open pressure relief door in
R compressor section R.H. front gas generator fairing
R (Ref. 72-03-00).

H. Enter air intake and gaining access through L.P. compressor blade spacing, clean V.I.G.V. inner pivot bushes by spraying cleaning fluid around each vane root (Ref. fig.701).

J. Enter cold stream duct and manually exercise system by pushing and pulling on push rods, to allow cleaning fluid to penetrate.

K. Return V.I.G.V. to minimum airflow position.

M. Close pressure relief door in compressor section R.H. front gas generator fairing (Ref. 72-03-00).

N. Remove working platform from cold stream duct.

P. Engines No.1 and 3

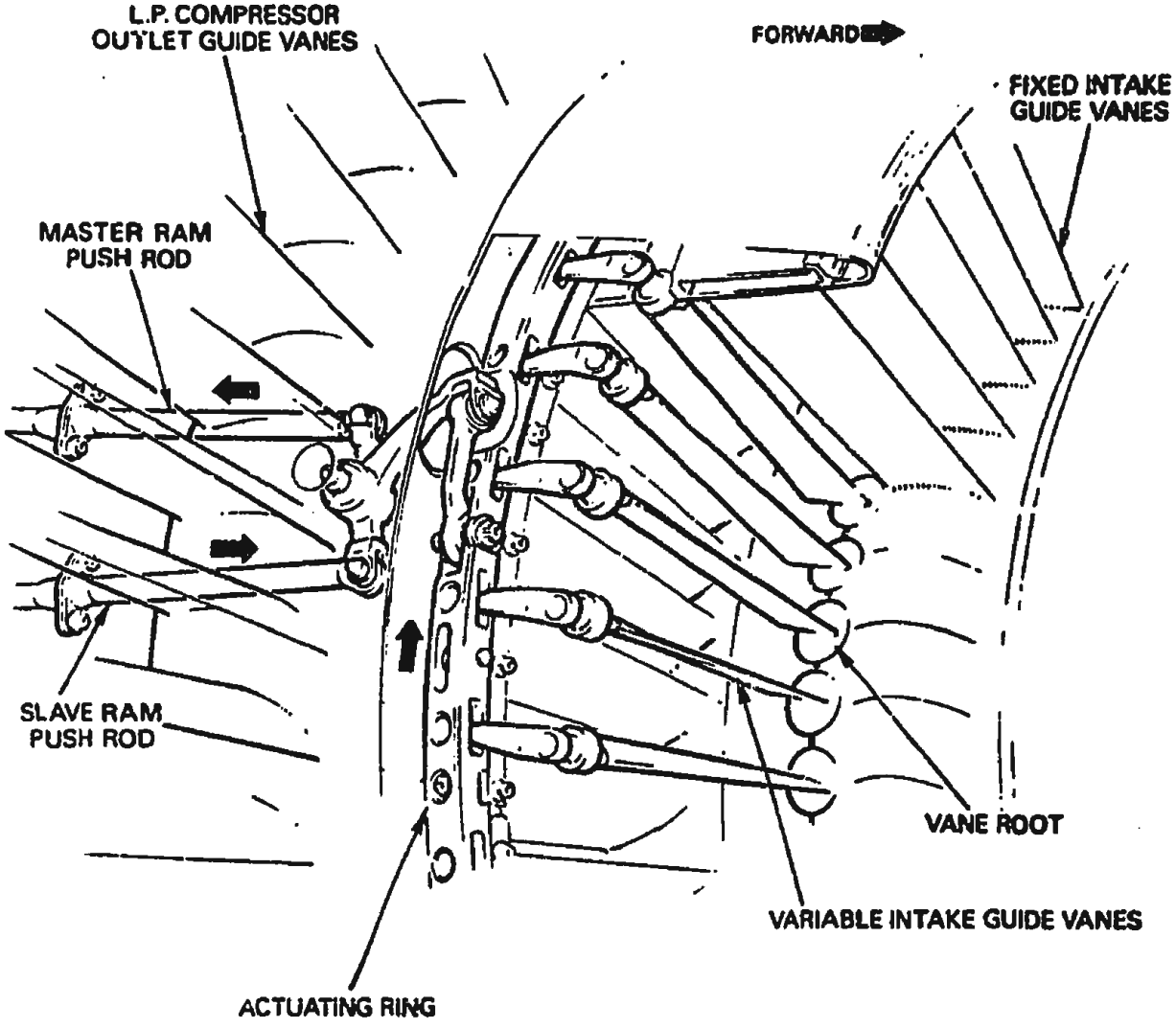
(1) Remove workmats or work platform from air intake.

Q. Engine No.2

(1) Remove work mats from air intake.

(2) Close access door 431AZ and L.H. hinged cowl 433AL (Ref. 71-12-01).

R. Unlock and reactivate thrust reverser and associated systems (Ref. 78-30-00).



NOTE: Arrows indicate movement to close VIGVs towards minimum airflow position.

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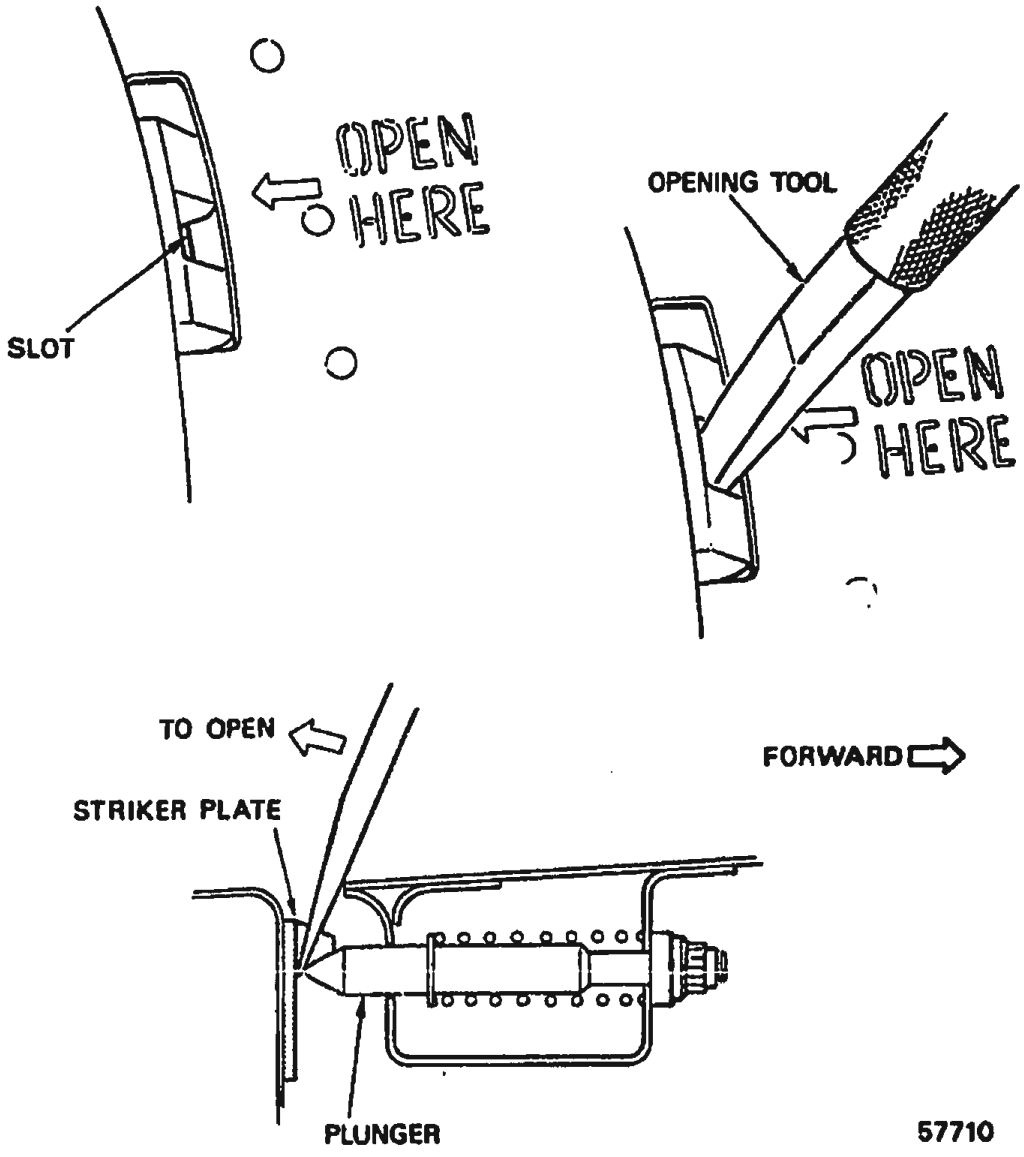
I.P. compressor airflow control system cleaning/painting
Fig.701



R Opening pressure relief door
R Fig.702

R EFFECTIVITY: ALL

INTAKE GUIDE VANE MASTER RAM AND CONTROL UNIT - MAINTENANCE PRACTICES

1. Removal/Installation Master Ram and Control Unit

Referenced Procedures:

70-51-00	Torque Tightening Techniques
71-00-00	Power Plant - Adjustment/Test
72-03-00	Gas Generator Fairings - Removal/Installation
72-31-01	L.P. Compressor Case and Vanes - Adjustment/Test
78-30-00	Thrust Reverser - Servicing

Illustrated Parts Catalogue references:

The I.P.C. sections where parts disturbed during the following operations can be located are as follows:

75-31-01	I.G.V. Master Ram and Control Unit Installation
75-31-02	I.G.V. Slave Ram Control Unit Installation
75-31-04	I.P. Compressor Control System Air Tubes

A. Remove Master Ram and Control Unit

(1) Equipment required:

CP.20309 or XUT.37594	Working platform
or (XUT.42526	Spacer
(XUT.42527	Side piece

(2) WARNING: ENSURE THRUST REVERSER SYSTEM IS LOCKED IN FORWARD THRUST POSITION WHILE WORK IS IN PROGRESS.
Deactivate and tag thrust reverser and associated systems, and fit thrust reverser mechanical locks (Ref. 78-30-00).

(3) Fit working platform in cold stream duct.

(4) Remove compressor section front R.H. fairing 412BR or 422BR for engines No.1 and 3, or 432BR for engine No.2 (Ref. 72-03-00).

(5) CAUTION: ENSURE ELECTRICAL CONNECTOR IS FREE FROM LIQUID AND/OR SOLID CONTAMINATION BEFORE DISCONNECTING. FAILURE TO DO SO COULD RESULT IN A FIRE.
Refer to fig.201, disconnect electrical connector (1).

C NOTE: The ram position indicator electrical connector has been deactivated and is being removed by M.0.94L15.

(6) Disconnect connector (2) and carefully ease tube clear of unit.

(7) Remove bolts and nuts (3) then manually separate push rod from master ram.

(8) Remove bolt, washer and clip (4).

(9) Disconnect connectors (5) and (6) then remove air tube.

(10) Remove bolt, washer and clip (7).

(11) Disconnect connectors (8) and (9) then remove air tube.

(12) Remove bolts (10) and carefully ease ram clear of locating dowels on compressor case.

(13) Fit approved blanks to all exposed apertures and connectors.

B. Install Master Ram and Control Unit

(1) Equipment required:

CP.20309 or XUT.37594	Working platform
or (XUT.42526	Spacer
(XUT.42527	Side piece

(2) Material required:

	British Spec./Ref.	American Spec./Ref.	OMat Item No.
Lockwire	DTD.189A 22 S.W.G.	- 21 A.W.G.	238

(3) Ensure thrust reverser is locked and systems are deactivated and tagged as detailed in operation A.(2).

(4) Ensure working platform is fitted in cold stream duct.

(5) Remove blanks, if fitted, from all apertures and connectors.

(6) Check V.I.G.V. linkage for freedom of movement.

(7) Refer to fig.201, position master ram on compressor case ensuring positive dowel location then secure with bolts (10).

(8) Correctly position air tube on master and slave rams then fit and secure (Ref. 70-51-00) connectors (9) and (8), and wirelock.

(9) Fit and secure clip, washer and bolt (7).

(10) Correctly position air tube on master and slave rams then fit and secure (Ref. 70-51-00) connectors (6) and (5), and wirelock.

(11) Fit and secure clip, washer and bolt (4).

(12) Bring ram and push rod mating flanges into abutment then fit and secure bolts and nuts (3).

NOTE: A correct size adjusting washer is selected at engine build and bonded to V.I.G.V. push rod, therefore no adjustment is normally necessary when changing ram. If however it is necessary to check the gap between the master ram and push rod for any reason refer to 72-31-01, Adjustment/Test.

(13) Fit and secure (Ref. 70-51-00) connector (2) and wirelock.

(14) CAUTION: ENSURE ELECTRICAL CONNECTOR IS FREE FROM LIQUID AND/OR SOLID CONTAMINATION BEFORE CONNECTING. FAILURE TO DO SO COULD RESULT IN A FIRE.
Connect and secure electrical connector (1).

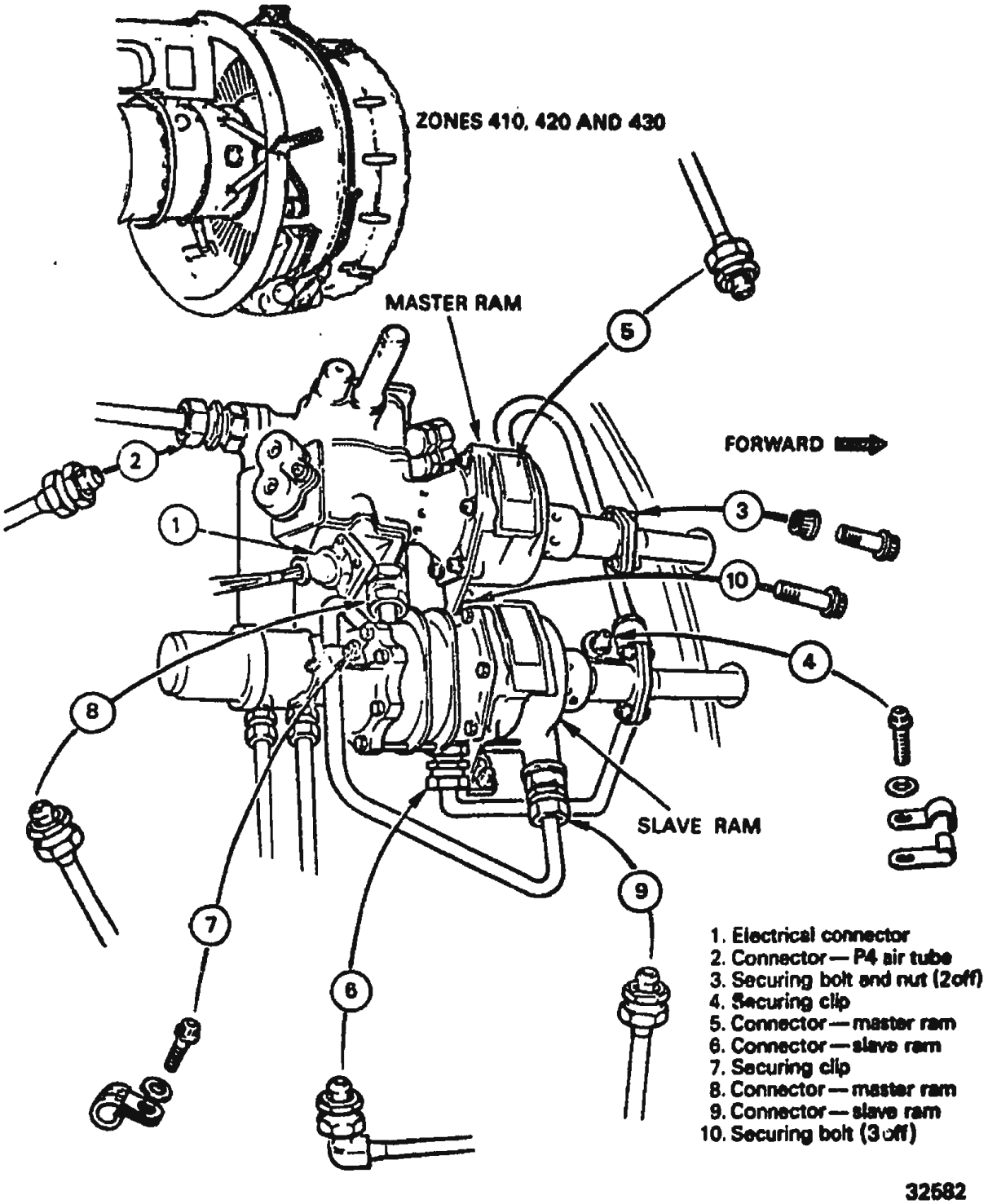
C NOTE: The ram position indicator electrical connector
C has been deactivated and is being removed by
C M.O.94L15

(15) Fit compressor section front R.H. fairing 412BR or 422 BR for engines No.1 and 3 or 432BR for engine No.2 (Ref. 72-03-00).

(16) Remove working platform.

(17) CAUTION: ON COMPLETION OF TEST ENSURE MASTER RAM IS FULLY RETRACTED TO PLACE V.I.G.V. IN MINIMUM AIRFLOW POSITION FOR ENGINE STARTING.
Functionally test I.P. compressor airflow control system (Ref. 71-00-00).

(18) Unlock and reactivate thrust reverser and associated systems (Ref. 78-30-00).



Master ram and control unit disconnect points
Fig.201

INTAKE GUIDE VANE SLAVE RAM AND BLEED VALVE CONTROL UNIT - MAINTENANCE PRACTICES

1. Removal/Installation Slave Ram and Bleed Valve Control Unit

Referenced Procedures:

	70-51-00	Torque Tightening Techniques
	72-03-00	Gas Generator Fairings - Removal/Installation
R	72-31-01	L.P. Compressor Case and Vanes - Adjustment/Test
	78-30-00	Thrust Reverser - Servicing

Illustrated Parts Catalogue references:

The I.P.C. sections where parts disturbed during the following operations can be located are as follows:

75-31-02	I.G.V. Slave Ram and Bleed Valve Control Unit Installation
75-31-04	I.P. Compressor Control System Air Tubes

A. Remove Slave Ram and Bleed Valve Control Unit

(1) Equipment required:

CP.20309 or XUT.37594	Working platform
or (XUT.42526	Spacer
(XUT.42527	Side piece

(2) WARNING: ENSURE THRUST REVERSER SYSTEM IS LOCKED IN FORWARD THRUST POSITION WHILE WORK IS IN PROGRESS.
Deactivate and tag thrust reverser and associated systems, and fit thrust reverser mechanical locks (Ref. 78-30-00).

(3) Fit working platform in cold stream duct.

(4) Remove compressor section front R.H. fairing 412BR or 422BR for engines No.1 and 3, or 432BR for engine No.2 (Ref. 72-03-00).

(5) Refer to fig.201, remove bolts and nuts (1) then manually separate push rod from ram.

(6) Remove bolt, washer and clip (2).

(7) Disconnect connectors (3) and (4) then remove air tube.

(8) Disconnect connectors (5) and (6) and carefully ease tubes clear of unit.

(9) Remove bolt, washer and clip (7).

(10) Disconnect connectors (8) and (9) then remove air tube.

(11) Remove bolts (10) and carefully ease ram clear of locating dowels on compressor case.

(12) Fit approved blanks to all exposed apertures and connectors.

B. Install Slave Ram and Bleed Valve Control Unit

(1) Equipment required:

CP.20309 or XUT.37594	Working platform
or (XUT.42526	Spacer
(XUT.42527	Side piece

(2) Material required:

	British Spec./Ref.	American Spec./Ref.	OMat Item No.
Lockwire	DTD.189A 22 S.W.G.	- 21 A.W.G.	238

(3) Ensure thrust reverser is locked and systems are deactivated and tagged as detailed in operation A.(2).

(4) Ensure working platform is fitted in cold stream duct.

(5) Remove blanks, if fitted, from all exposed apertures and connectors.

(6) Check V.I.G.V. linkage for freedom of movement.

(7) Refer to fig.201, position slave ram on compressor case ensuring positive dowel location then secure with bolts (10).

(8) Correctly position air tube on master and slave rams then fit and secure (Ref. 70-51-00) connectors (9) and (8), and wirelock.

(9) Fit and secure clip, washer and bolt (7).

(10) Fit and secure (Ref.70-51-00) connectors (6) and (5), and wirelock.

(11) Correctly position air tube on master and slave rams then fit and secure (Ref. 70-51-00) connectors (4) and (3), and wirelock.

(12) Fit and secure clip, washer and bolt (2).

(13) Bring ram and push rod mating flanges into abutment then fit and secure bolts and nuts (1).

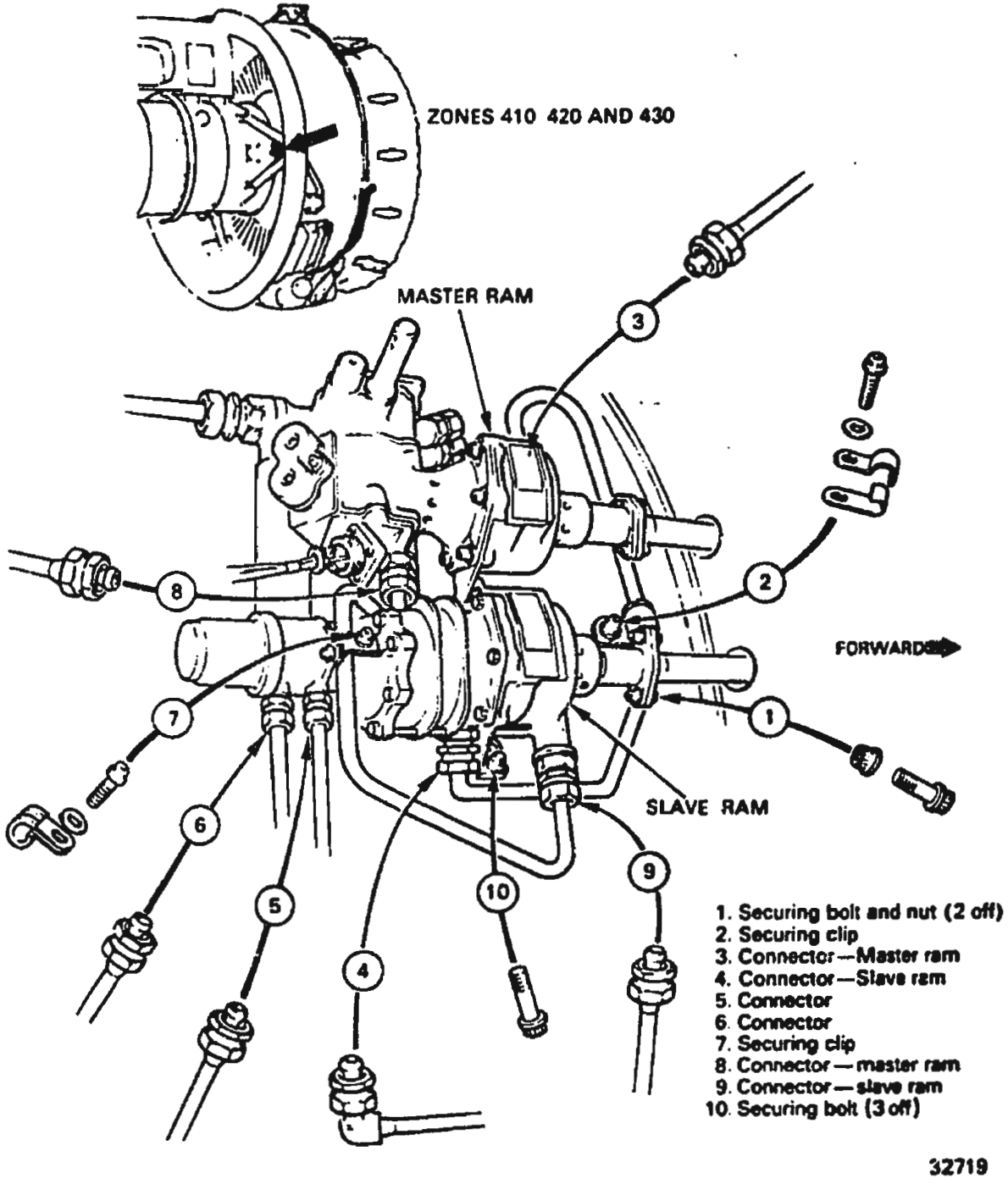
NOTE: A correct size adjusting washer is selected at engine build and is bonded to V.I.G.V. push rod, therefore no adjustment is normally necessary when changing ram. If however it is necessary to check the gap between the slave ram and push rod for any reason refer to 72-31-01, Adjustment/Test.

CR (14) CAUTION: ON COMPLETION OF TEST ENSURE MASTER RAM IS
CR FULLY RETRACTED TO PLACE V.I.G.V. MINIMUM
CR AIRFLOW POSITION FOR ENGINE STARTING.

R (15) Install compressor section front R.H. fairing 412BR or 422BR for engines No.1 and 3, or 432BR for engine No.2 (Ref. 72-03-00).

R (16) Remove working platform.

R (17) Unlock and reactivate thrust reverser and associated systems (Ref. 78-30-00).



Intake guide vane slave ram and bleed valve control unit disconnect points
Fig.201

I.P. COMPRESSOR AIR BLEED VALVE - MAINTENANCE PRACTICES

1. I.P. Compressor Air Bleed Valve Removal/Installation

WARNING: ENSURE THRUST REVERSER SYSTEM IS LOCKED IN FORWARD THRUST POSITION (REF. 78-30-00, SERVICING) WHILE WORK IS IN PROGRESS.

NOTE: The procedure for removal/installation of both I.P. bleed valves is similar.

A. Remove air bleed valve and duct.

(1) Equipment required:

CP.20309 Working platform

(2) Tag throttle control levers and thrust reverser levers. Tag APU/GRD AIR TO REVERSERS switches.

(3) On pilots overhead circuit breaker panel CB1, zone 210, open and tag appropriate THRUST REVERSE circuit breaker.

(4) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag appropriate START AIR VALVE circuit breaker.

(5) Tag appropriate ENGINE START panel switchlights.

(6) Position working platform in cold stream duct.

(7) Enter cold stream duct and remove compressor section L.H. and R.H. front gas generator fairings (Ref. 72-03-00, Removal/Installation).

NOTE: If bleed valve only is to be removed, there is no need to remove gas generator fairings.

(8) Refer to fig.201, remove bolts and washers (1).

(9) Remove bolts and washers (2) then remove bleed valve (3) and duct (4) from compressor case.

(10) Fit approved blanks to all exposed apertures and connectors.

B. Install air bleed valve and duct.

(1) Equipment required:

CP.20309 Working platform

(2) Ensure appropriate systems are tagged as detailed in operations A (2) through (5).

(3) Ensure working platform is positioned in cold stream duct.

(4) Enter cold stream duct, remove blanks if fitted, from all connectors and apertures.

(5) Refer to fig.201, enter air tube through slot in duct (4) and align holes in duct and compressor case.

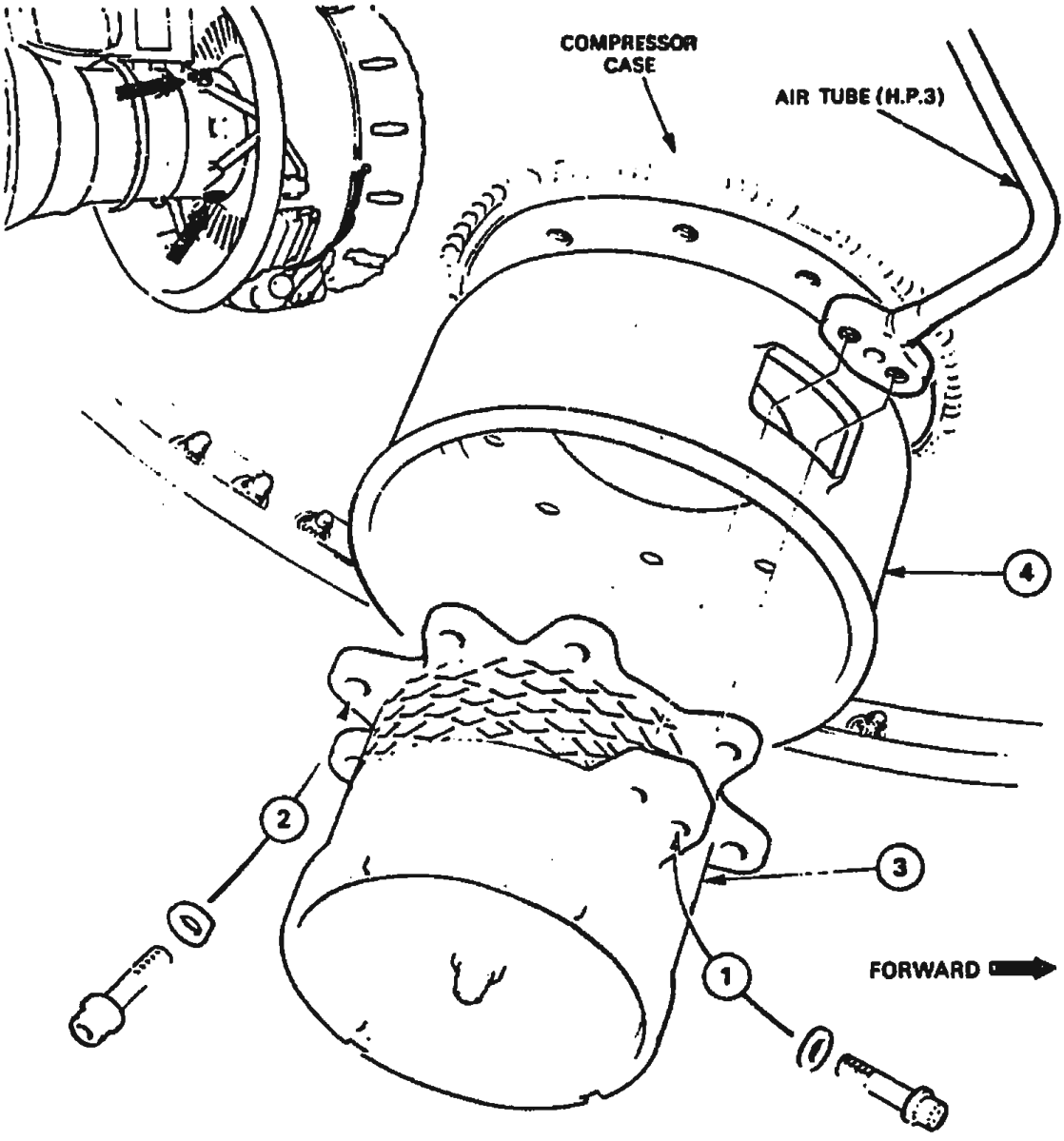
(6) Fit bleed valve (3) inside duct (4), ensuring correct location of air tube on bleed valve connector, then fit and secure bolts and washers (2).

(7) Secure air tube to bleed valve connector with bolts and washers (1).

(8) Fit compressor section L.H. and R.H. front gas generator fairings (Ref. 72-03-00, Removal/Installation).

(9) Remove working platform from cold stream duct.

(10) Remove tags and close circuit breakers opened in operations A. (2) through (5).



1. Securing bolt and washer (2 off) – H.P.3 air connector
2. Securing bolt and washer (8 off)
3. Bleed valve
4. Duct

26893

I.P. compressor air bleed valve and duct removal/installation
Fig.201

R CENTRISEP AIR CLEANER - MAINTENANCE PRACTICES

R 1. Removal/Installation Centrisep Air Cleaner

R Service Bulletins referred to:

R S.B.75-4896 - Introduction of Centrisep Air Cleaner with
R Overboard Vent.
R S.B.75-5159 - Introduction of Centrisep Air Cleaner without
R Overboard Vent.

R Referenced Procedures:

R 70-51-00 Torque Tightening Techniques.
R 72-03-00 Gas Generator Fairings - Removal/Installation.
R 78-30-00 Thrust Reverser - Servicing.

R Illustrated Parts Catalogue References:

R The I.P.C. sections where parts disturbed during the following
R operations can be located are as follows:

R 75-31-04 I.P. Compressor Control System Air Tubes
R 75-31-07 Centrisep Cleaner.

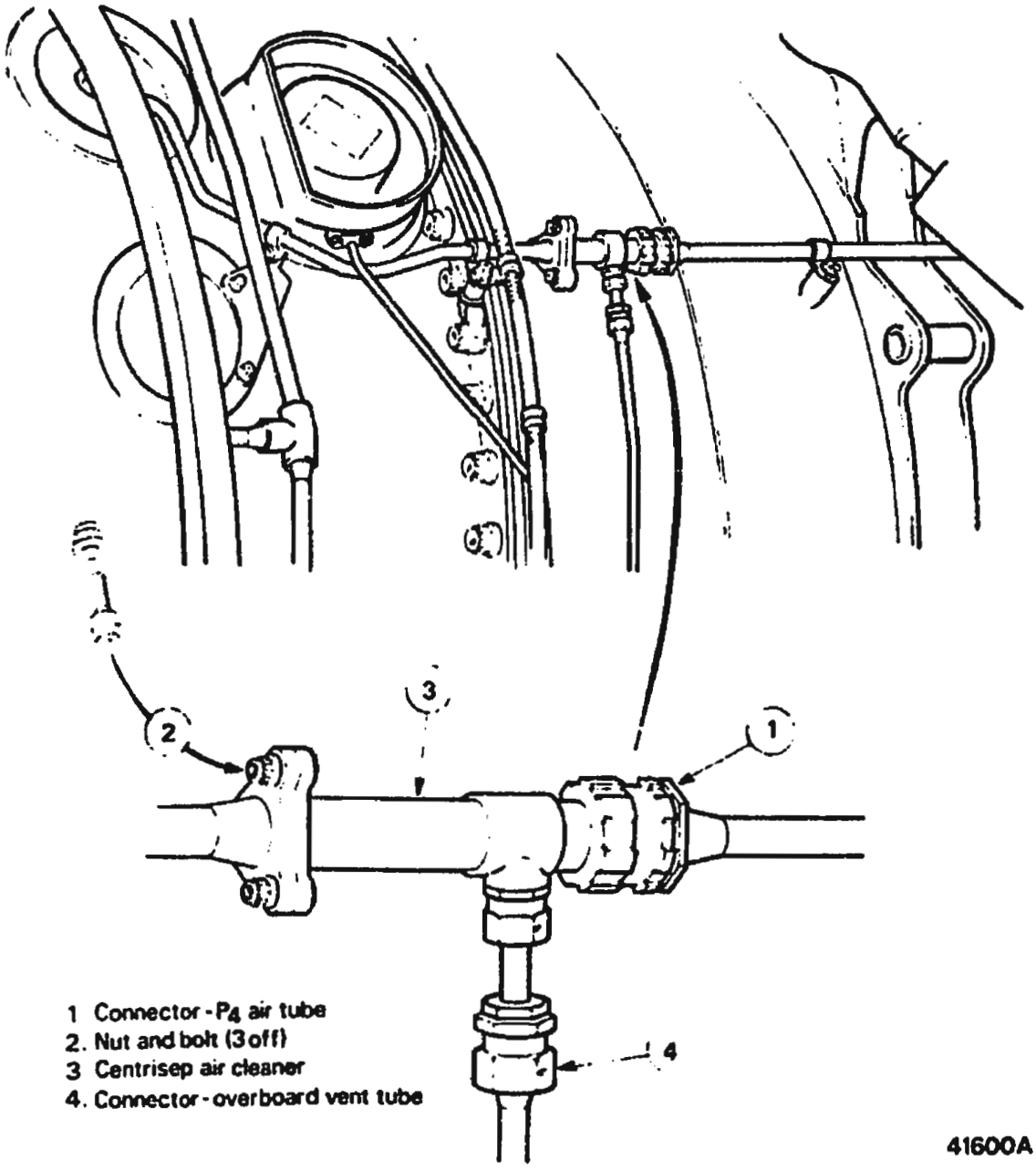
R A. Remove centrisep air cleaner

R (1) Equipment required:

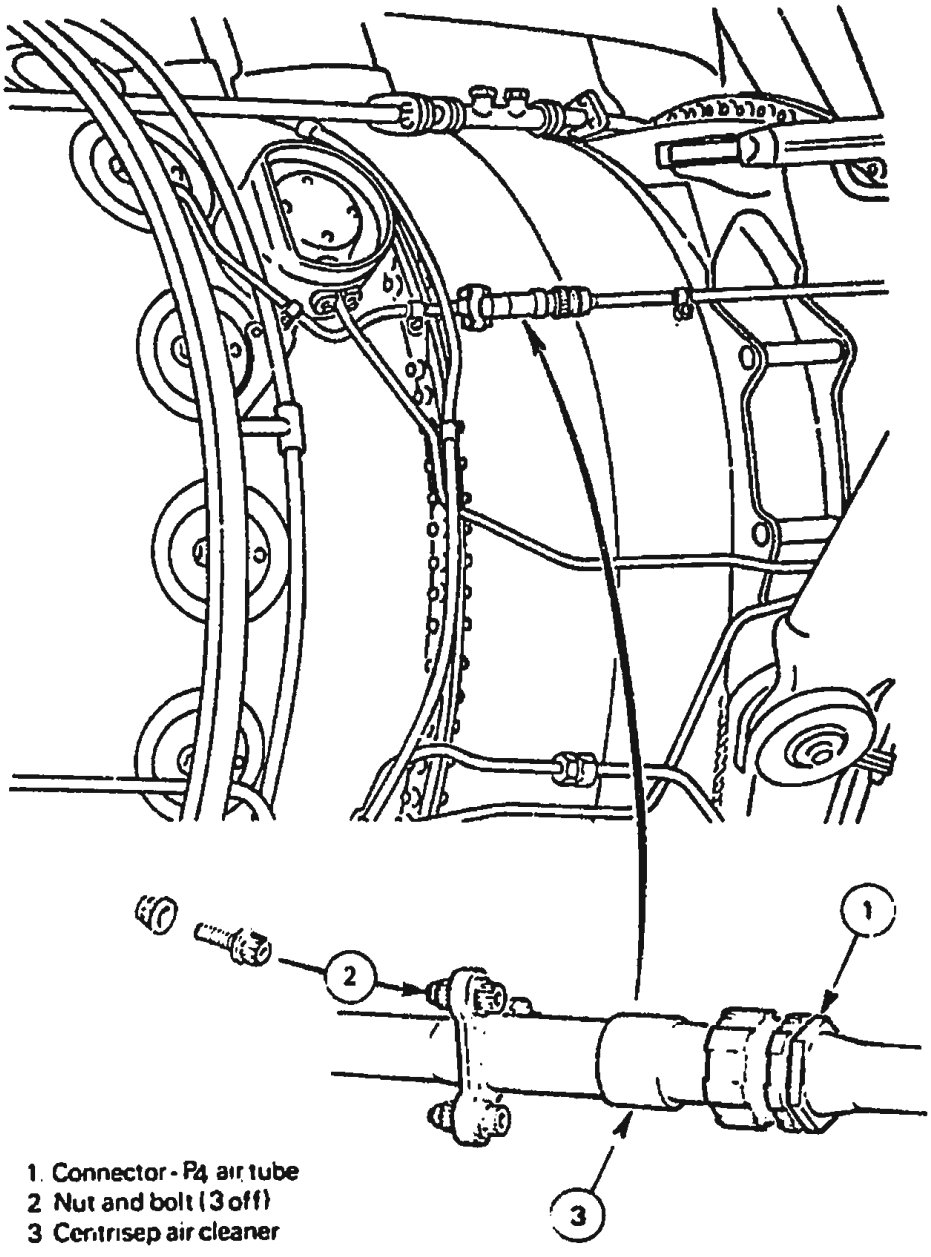
R CP20309 or XUT37594 Working platform
R or (XUT 42526 Spacer
R (XUT 42527 Side piece

R (2) WARNING: ENSURE THRUST REVERSER SYSTEM IS LOCKED IN
R FORWARD THRUST POSITION WHILE WORK IS IN
R PROGRESS
R Deactivate thrust reverser and associated systems,
R fit thrust reverser mechanical locks (Ref.78-30-00).

R (3) Position working platform in cold stream duct.



R Centrisep air cleaner disconnect points - Engine
R with S.B.75-4896
R Fig.201



1. Connector - P4 air tube
2 Nut and bolt (3 off)
3 Centrisep air cleaner

41601

R Centrisep air cleaner disconnect points - Engine
R with S.B.75-5159
R Fig.202

R EFFECTIVITY: ALL

R (4) Remove compressor section right-hand rear fairing
R 412FR or 422FR for engine No.1 and No.3, or 432FR for
R engine No.2 (Ref. 72-03-00).

R (5) On engines with S.B.75-4896 refer to fig.201, disconnect
R connectors (1) and (2) then remove bolts and nuts (3)
R and centrisep air cleaner (4).

R On engines with S.B.75-5159 refer to fig.202, disconnect
R connector (1) then remove bolts and nuts (2) and
R centrisep air cleaner (3).

R (6) Fit blanks to all exposed apertures and connectors.

R B. Install centrisep air cleaner

R (1) Equipment required:

R CP20309 or XUT37594		Working platform
R or (XUT42526		Spacer
R (XUT42527		Side piece

R (2) Material required:

R		British Spec./Ref.	American Spec./Ref.	CMat Item No.
R	Lockwire	DTD189A 22 S.W.G.	-	238
R			21 A.W.G.	

R (3) Ensure thrust reverser is locked and systems deactivated
R as detailed in operation 1.A.(2).

R (4) Ensure working platform is positioned in cold stream
R duct.

R (5) Remove blanks from all apertures and connectors.

(6) On engines with S.B.75-4896 refer to fig.201, position centrisep air cleaner (4) fit, but do not tighten bolts and nuts (3).

(a) Connect and secure (Ref. 70-51-00) connector (1) then tighten bolts and nuts (3), wirelock connector (1).

(b) Fit and secure (Ref. 70-51-00) connector (2) and wirelock.

(7) On engines with S.B.75-5159, refer to fig.202, position centrisep air cleaner (3) fit, but do not tighten bolts and nuts (2).

(a) Connect and secure (Ref. 70-51-00) connector (1) then tighten bolts and nuts (2), wirelock connector (1).

(8) Refit compressor section fairing removed in operation 1.A.(4).

(9) Remove working platform from cold stream duct.

(10) Unlock and reactivate thrust reverser and associated systems (Ref. 78-30-00).

CR 2. Removal/Installation TWA Centrisep Air Cleaner

CR The following procedure applies to VIGV Centrisep Air Cleaner
CR installed by TWA MO 99731.

CR I.P.C. Reference:
CR 75-31-04 I.P.compressor control system air tubes.

CR A. Remove Centrisep Air Cleaner

CR (1) Deactivate thrust reverser, fit thrust reverser
CR mechanical locks.

CR (2) Position working platform in cold stream duct.

CR (3) Remove compressor section R.H. rear fairing
CR (Ref. 72-03-00).

CR (4) Refer to fig.203, remove lock wire installed over clamp.
CR Remove clamp, connector nuts and centrisep air cleaner.

CR (5) Fit blanks to exposed tube ends.

CR B. Install Centrisep Air Cleaner

CR (1) Ensure thrust reverser is locked and systems deactivated.

CR (2) Position working platform in cold stream duct.

CR (3) Remove blanks from all tube ends.

CR (4) Refer to fig.203, position centrisep air cleaner and
CR fit connecting nuts.

CR (5) Secure connecting nuts by tightening to recommended
CR torque value.

CR (6) Install clamp to exhaust tube and attach to compressor
CR case standoff.

CR (7) Install lock wire to orfice tube, routing wire over
CR outside of clamp.

CR (8) Refit compressor section fairing removed in step 1.A.(3).

CR (9) Unlock and reactivate thrust reverser.

R 3. Centrisep Air Cleaner - Inspection/Check

R The following procedure is only applicable to Centrisep Cleaner
R part number QB 0190 introduced by S.B.75-5159

R A. Centrisep Filter Inspection

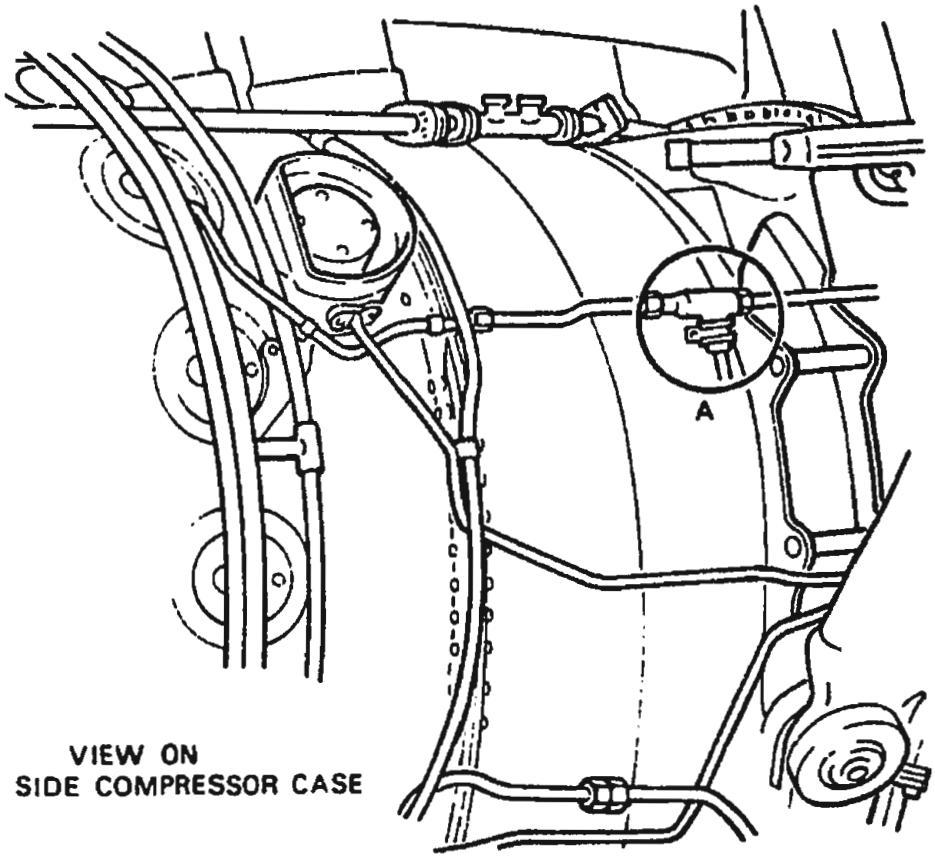
R (1) Remove centrisep air cleaner (Ref. para.1.A.).

R (2) Visually inspect inlet filter for signs of damage or
R blockage due to contamination.

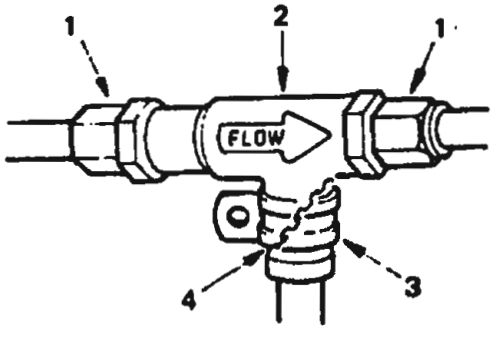
R (3) Clean by reverse flowing clean dry air through the
R unit (Max. pressure 100 p.s.i.).

R (4) If cleaning fails to remove the contamination or
R filter is found damaged reject unit for repair.

R (5) Install centrisep air cleaner (Ref. para.1.B.).



VIEW ON
R.H SIDE COMPRESSOR CASE



VIEW A

1 An connector nuts
2 Centrisep air cleaner
3 Clamp
4 Safety wire

49228A

CR
CR
Centrisep air cleaner disconnect points engine
Fig.203

R
R
050B
EFFECTIVITY: ALL

1A

H.P. COMPRESSOR AIRFLOW CONTROL SYSTEM - DESCRIPTION AND OPERATION

1. General

To achieve optimum airflow through the H.P. compressor during engine starting and the lower speed range, a percentage of stage 3 air (H.P.3) is vented into the engine cold stream duct through two bleed valves. The left-hand bleed valve is controlled by a switch in the H.P. Engine Shaft Speed (N3) Indicator (Ref. 77-12-00) and the right-hand bleed valve is controlled by the Intermediate Pressure Compressor Airflow Control System (Ref. 75-31-00).

R On engines with S.B.71-5474 the left-hand bleed valve is
R controlled by the P4/PF switch (Ref. 73-21-00).

The automatic control system of the left-hand bleed valve comprises a bleed valve, a bleed valve control unit and an electrical switch, which works in conjunction with the H.P. bleed relay of the Engine Starting System (Ref. 80-11-00).

The right-hand bleed valve is automatically controlled by the bleed valve control unit of the I.P. compressor airflow control system.

Fig.1 (Sheets 1 and 2) show the location of the system units
R and tubes in zones 412, 422 and 432 and fig.2 and 3 illustrate the system operation diagrammatically.

2. Description

R The left-hand bleed valve piston (Ref. fig.2 and 3) is subjected to H.P.3 air on the top side (closing force) and H.P.3 air and spring pressure on the underside (opening force).

When energized the H.P. compressor bleed valve control unit valve closes to shut-off the vent of air from the underside of the bleed valve piston. Spring pressure and H.P.3 air acting on the underside of the piston holds the bleed valve open. When de-energized the control unit allows the air from the underside of the piston to vent and the bleed valve closes.

The H.P. compressor bleed valve control unit is energized through contacts in the H.P. bleed relay, which is controlled by a switch in the N3 indicator. During starting the relay is energized and the bleed valve is open. At approximately 51 to 53% N3 the switch opens, de-energizing the relay and therefore the control unit, and the bleed valve closes.

R On engines with S.B.71-5474, the bleed valve control unit is
R energized through the P4/PF switch contacts (Ref. fig.3) that
R open when the engine reaches approximately 68% N3.

The right-hand bleed valve (Ref. fig.2and 3) closes and opens as scheduled by the I.P. compressor airflow control system.

A. H.P. Compressor Bleed Valve Control Unit

The bleed valve control unit (Ref. fig.1, Sheet 1) is located on the right-hand side of the high-speed external gearbox input drive housing in zones 412, 422 and 432. The unit controls the venting from the underside of the left-hand bleed valve piston.

R The unit (Ref. fig.2 and 3) consists of a solenoid and spring loaded valve housed in a body incorporating an electrical receptacle, an air inlet port and outlet vent.

The valve is positioned by the spring to allow airflow from the inlet port to pass through the unit to the outlet vent. When energized the solenoid moves the valve against spring pressure to close off the vent and prevent airflow through the unit.

Should the solenoid remain energized after the predetermined N3 speed has been reached, spring pressure and increasing H.P.3 air will eventually overcome the magnetic force of the solenoid and open the valve. Air from the underside of the bleed valve piston will vent, thus allowing the bleed valve to close.

B. H.P. Compressor Bleed Valves

The bleed valves are located (Ref. fig.1, Sheets 1 and 2) on the combustion outer case in zones 412, 422 and 432.

R The left-hand bleed valve (Ref. fig.2 and 3) comprises a spring loaded piston attached to a hollow stem, housed in a cylindrical body that incorporates outlet ports.

H.P.3 air flows through the hollow stem to the top of the piston and also through a drilling in the stem to the underside of the piston. The underside of the piston is connected through rigid tubing to the inlet port on the H.P. compressor bleed valve control unit.

In the open position the piston allows a percentage of H.P.3 air to vent through the outlet ports into the engine cold stream duct; in the closed position the piston closes off the outlet ports.

R The right-hand bleed valve (Ref. fig.2 and 3) is basically similar to the left-hand, except that it has a double spring. The underside of the piston is connected through rigid tubing to the I.P. compressor bleed valve control unit.

The left and right-hand bleed valves are not interchangeable. To prevent the valves being inadvertently fitted in the wrong position, the right-hand bleed valve cap is painted yellow for identification.

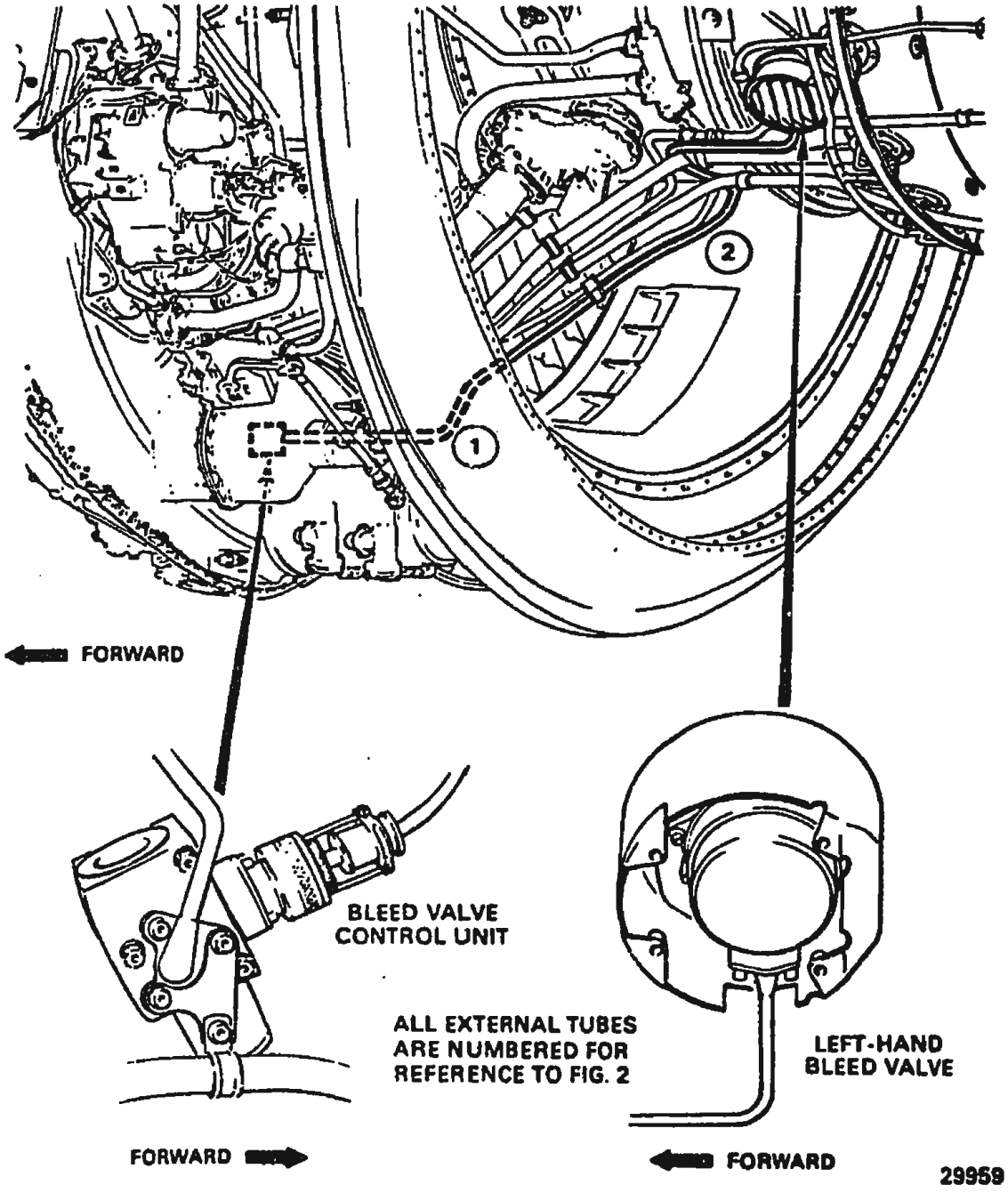
On engines incorporating S.B.75-2248 - Baulking features for right-hand valve, and right-hand H.P. bleed valves incorporating Dunlop S.B.75-02 (Mod.E.409) - Introduction of valve AC65130 - baulking features ensure that the right-hand bleed valve is fitted in the correct position.

C. H.P. Compressor Airflow Control System Air Tubes

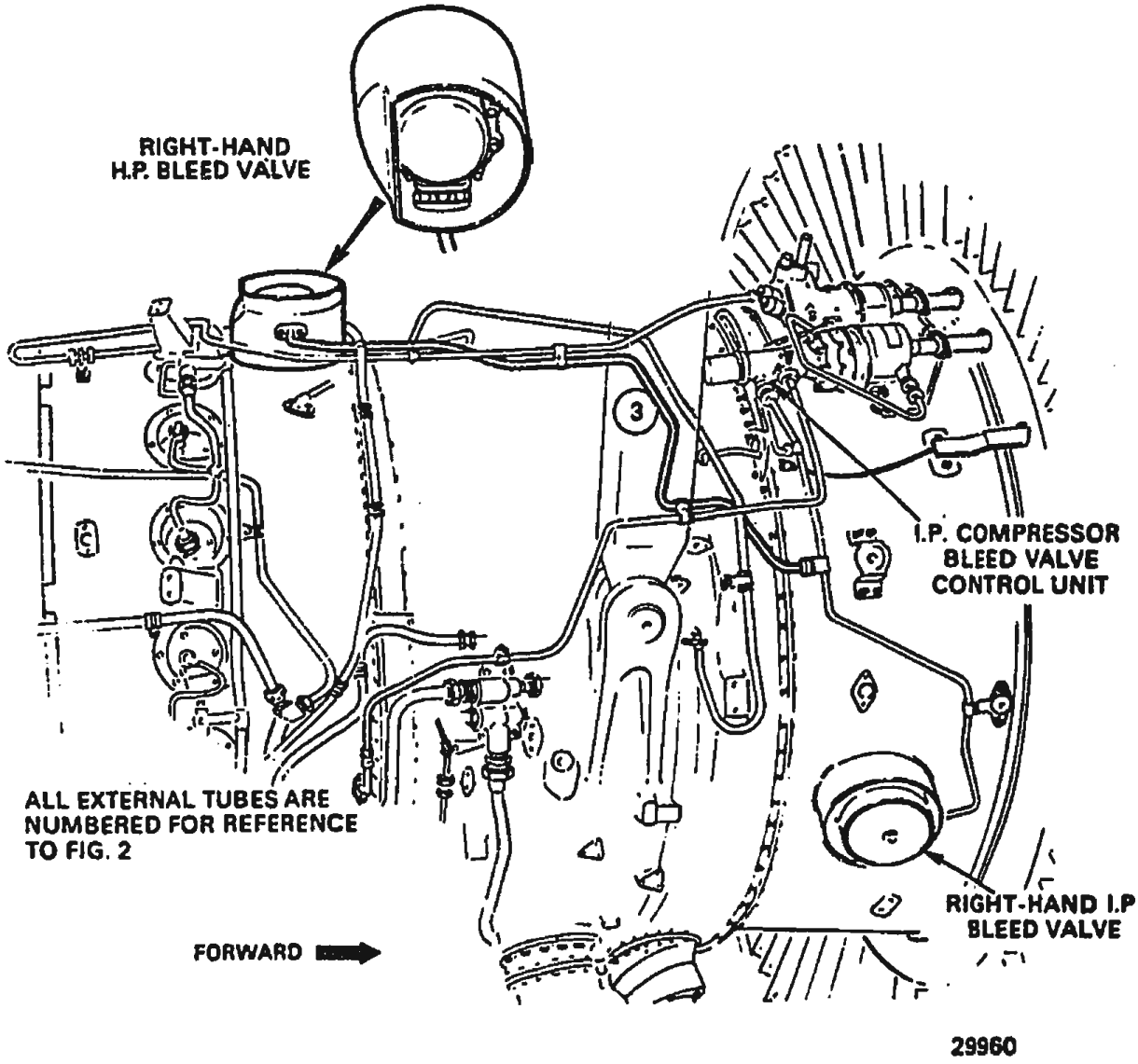
From the bleed valve control unit (Ref. fig.1, Sheet 1) a rigid tube is routed to the services disconnect platform. From the disconnect platform a rigid tube connects to a Tee piece in the rigid tube to the left-hand H.P. bleed valve, the other end of this tube being blanked.

On engines incorporating S.B.75-2042 - Re-run air tubes - a one piece rigid tube is routed from the disconnect platform to the left-hand H.P. bleed valve.

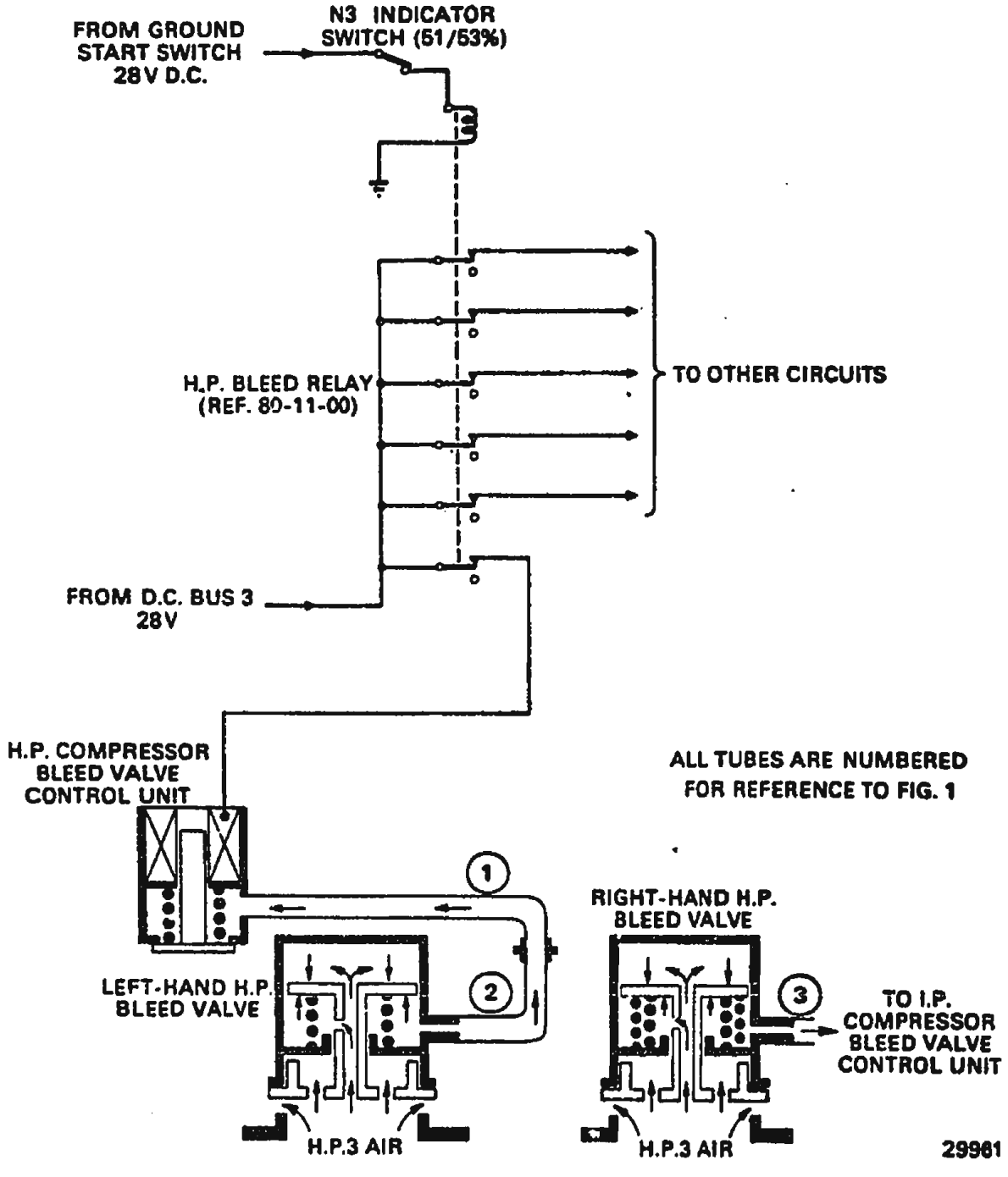
From the right-hand H.P. bleed valve (Ref. fig.1, Sheet 2) a rigid tube is routed to a Tee piece in the rigid tube which connects the I.P. compressor bleed valve control unit to the right-hand I.P. bleed valve.



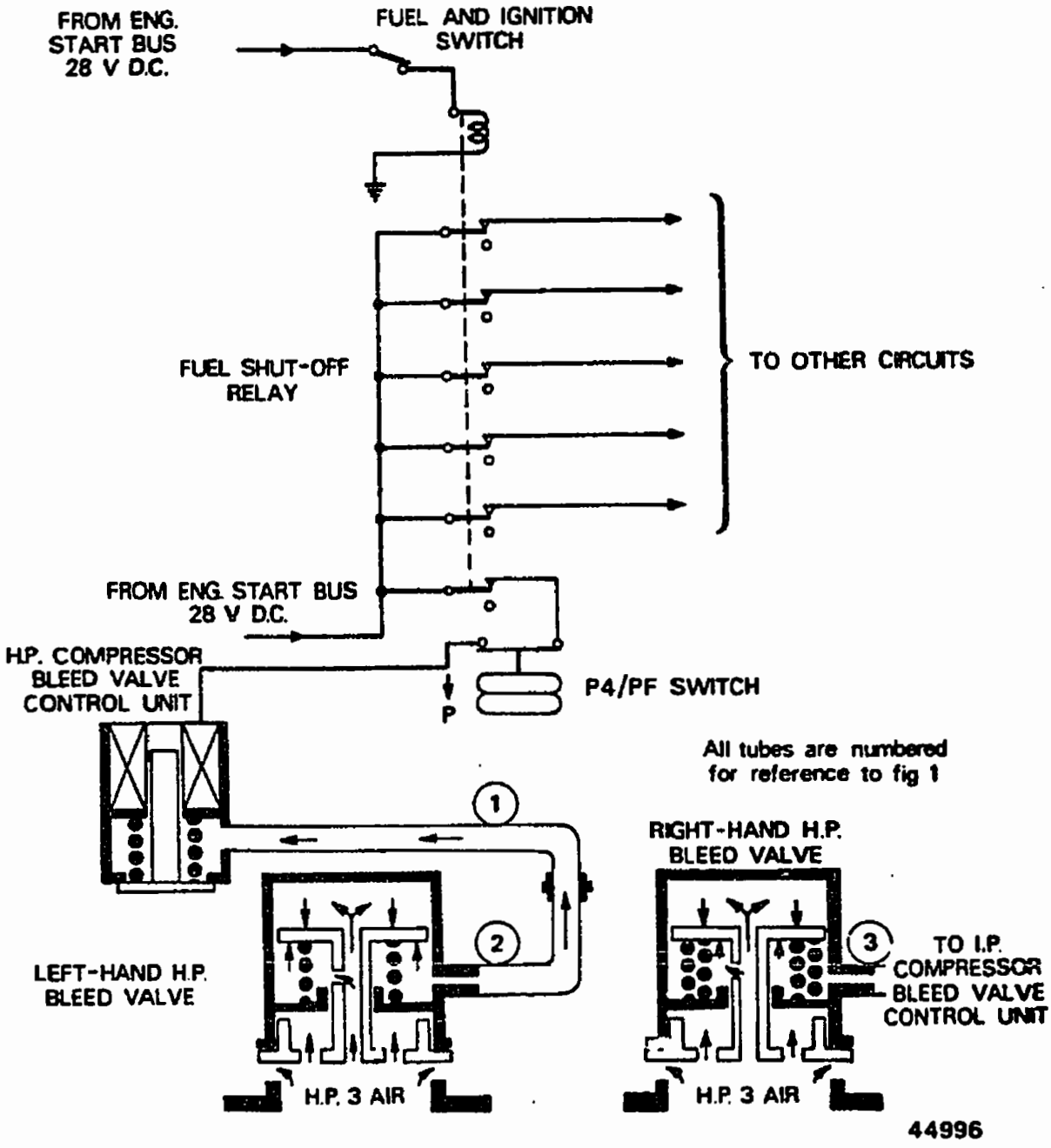
H.P. compressor airflow control system units and tubes
Fig.1 (Sheet 1)



H.P. compressor airflow control system units and tubes
Fig.1 (Sheet 2)



H.P. compressor airflow control system operation - engines without S.B.71-5474
Fig.2



R H.P. compressor airflow control system operation - engines with S.B.71-5474
R Fig.3
R

3. Operation

R Engines without S.B.71-5474 (Ref. fig.2)

During starting the N3 indicator switch is closed, the H.P. bleed relay and the bleed valve control unit solenoid are energized, thus the left-hand bleed valve is held open by H.P.3 air and spring pressure.

When the engine reaches 51 to 53% N3 the N3 indicator switch opens, de-energizing the H.P. bleed relay and the bleed valve control unit solenoid. Spring pressure moves the control unit valve to vent air from the underside of the left-hand bleed valve piston and H.P.3 air moves the piston against spring pressure to close off the outlet ports.

The right-hand bleed valve operates in conjunction with the I.P. compressor bleed valves as described in 75-31-00.

R Engines with S.B.71-5474 (Ref. fig.3)

R During starting the fuel shut-off relay and the P4/PF switch
R are made, and connect a 28 V dc electrical supply to the bleed
R valve control unit solenoid causing the left-hand bleed valve
R to be held open.

R When the engine reaches approximately 68% N3 the P4/PF switch
R opens (Ref. 73-21-00) de-energizing the bleed valve control
R unit solenoid. Spring pressure moves the control unit valve
R to vent air from the underside of the left-hand bleed valve
R piston and H.P.3 air moves the piston against spring pressure
R to close off the outlet ports.

H.P. COMPRESSOR BLEED VALVE CONTROL UNIT - MAINTENANCE PRACTICES

Referenced Procedures:

71-11-00 Cowling, Engines No.1 and No.3 - Servicing
71-12-01 L.H. and R.H. Lower Hinged Cowl - Servicing
24-41-00 External Power/Ground Service System - Maintenance Practices.

Illustrated Parts Catalogue References:

The I.P.C. sections where parts disturbed during the following operations can be located are as follows:

75-32-04 H.P.3 Air Tubes
75-32-01 H.P. Compressor Bleed Valve Control Unit

Service Bulletins referred to:

S.B.76-4312 - Introduction of stiffer bracket for H.P.3 bleed valve solenoid and A.I.D.S. throttle transducer
S.B.75-5250 - Repositioned H.P.3 bleed valve solenoid
R S.B.71-5474 - H.P.3 left hand bleed valve switching function
R interchanged with min F/N solenoid release.

1. Removal/Installation H.P. Compressor Bleed Valve Control Unit

A. Remove Bleed Valve Control Unit

(1) Tag appropriate ENGINE START panel switchlight.

(2) Open and tag appropriate START AIR VALVE circuit breaker (N3, N9 or N15) on Flight Engineer/Second Officers aft circuit breaker panel CB3, Zone 215.

(3) Open left-hand hinged cowl 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433AL for engine No.2 (Ref. 71-12-01).

(4) CAUTION: ENSURE ELECTRICAL CONNECTOR IS FREE FROM LIQUID AND/OR SOLID CONTAMINATION BEFORE DISCONNECTING.
Refer to fig.201, 202 or 203 as applicable, disconnect electrical connector (1).

(5) On engine No.2, release drains vent tube support clip from bracket (2).

(6) Note position of bracket (2) for installation purposes then disconnect connector (3).

(7) Remove bolts and washers (4) or remove nuts (5), bolts and washers (4) as applicable then withdraw bleed valve control unit from mounting bracket.

(8) Fit approved blanks to all exposed connectors.

B. Install Bleed Valve Control Unit

(1) Ensure appropriate systems are isolated as detailed in operations A. (1) and (2).

(2) Remove blanks, from all connectors.

(3) Refer to fig.201, 202 or 203 as applicable, position bleed valve control unit on mounting bracket and secure with bolts and washers (4) or secure with nuts (5), bolts and washers (4) as applicable.

(4) Position bracket (2) as noted in operation A. (6) then connect and secure connector (3).

(5) On engine No.2, secure drains vent tube support clip to bracket (2).

(6) CAUTION: ENSURE ELECTRICAL CONNECTOR IS FREE FROM LIQUID AND/OR SOLID CONTAMINATION BEFORE CONNECTING.
Connect and secure electrical connector (1).

(7) Remove tag and close circuit breakers opened in operations A. (1) and (2).

R (8) Close left-hand hinged cowl 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433AL for engine No.2 (Ref. 71-12-01).

R 2. Adjustment/Test H.P. Compressor Bleed Valve Control Unit Solenoid - Engines without S.B.71-5474

A. Operational Test

(1) Open and tag appropriate START AIR VALVE circuit breaker (N3, N9 or N15) on Flight Engineer/Second Officers aft circuit breaker panel CB3/Zone 215.

(2) Open left-hand hinged cowl 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433AL for engine No.2 (Ref. 71-12-01).

(3) Connect and energize external power system (Ref.24-41-00).

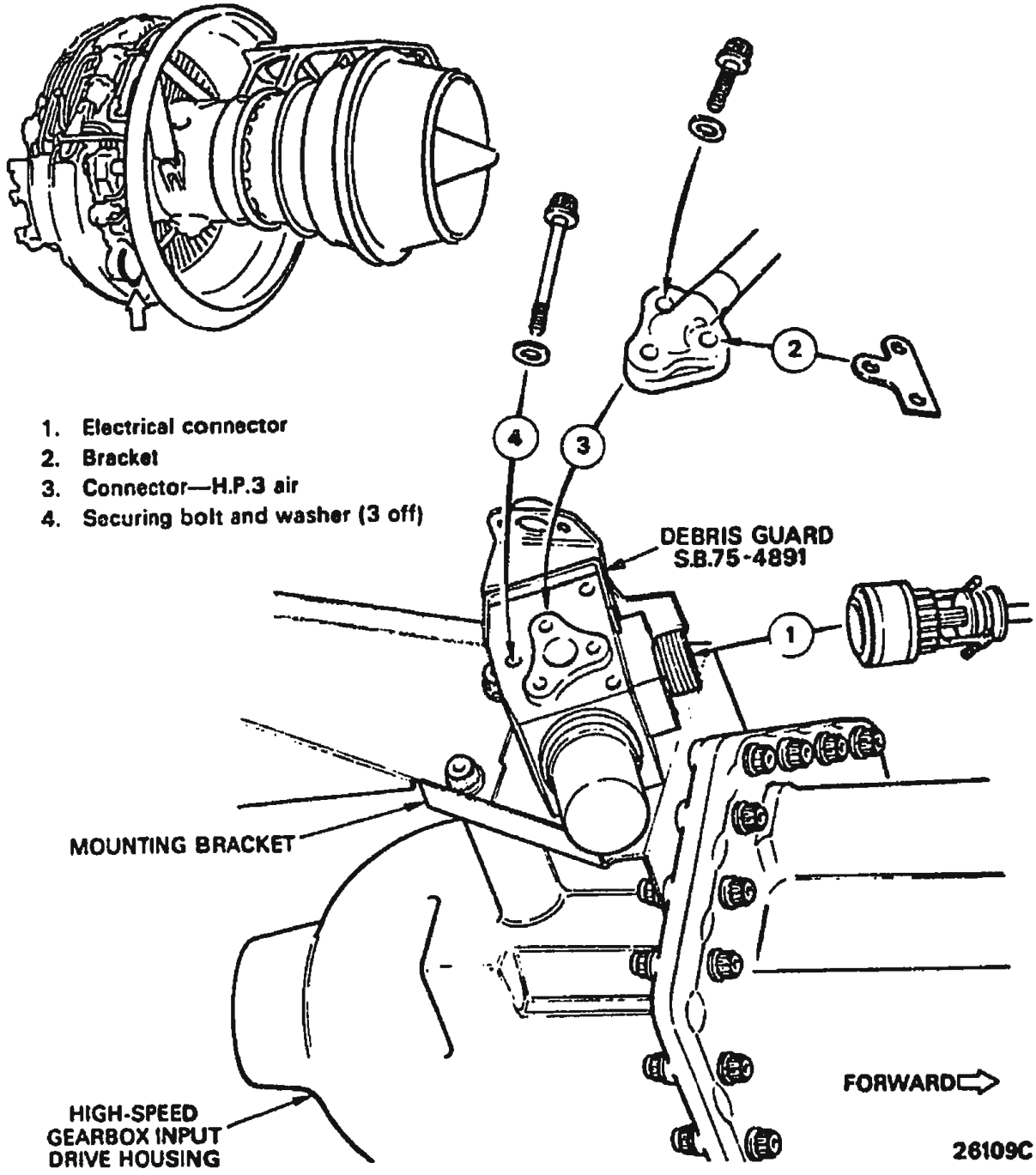
(4) Press appropriate GROUND START switchlight, Zone 210, and aurally check for bleed valve control unit solenoid operation.

(5) Press appropriate GND START RELEASE switchlight, Zone 210.

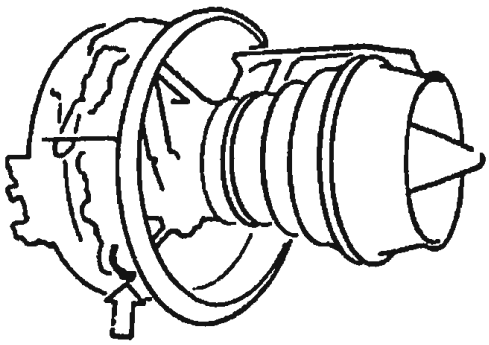
(6) De-energize and disconnect external power system (Ref.24-41-00).

(7) Close left-hand hinged cowl 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433AL for engine No.2 (Ref. 71-12-01).

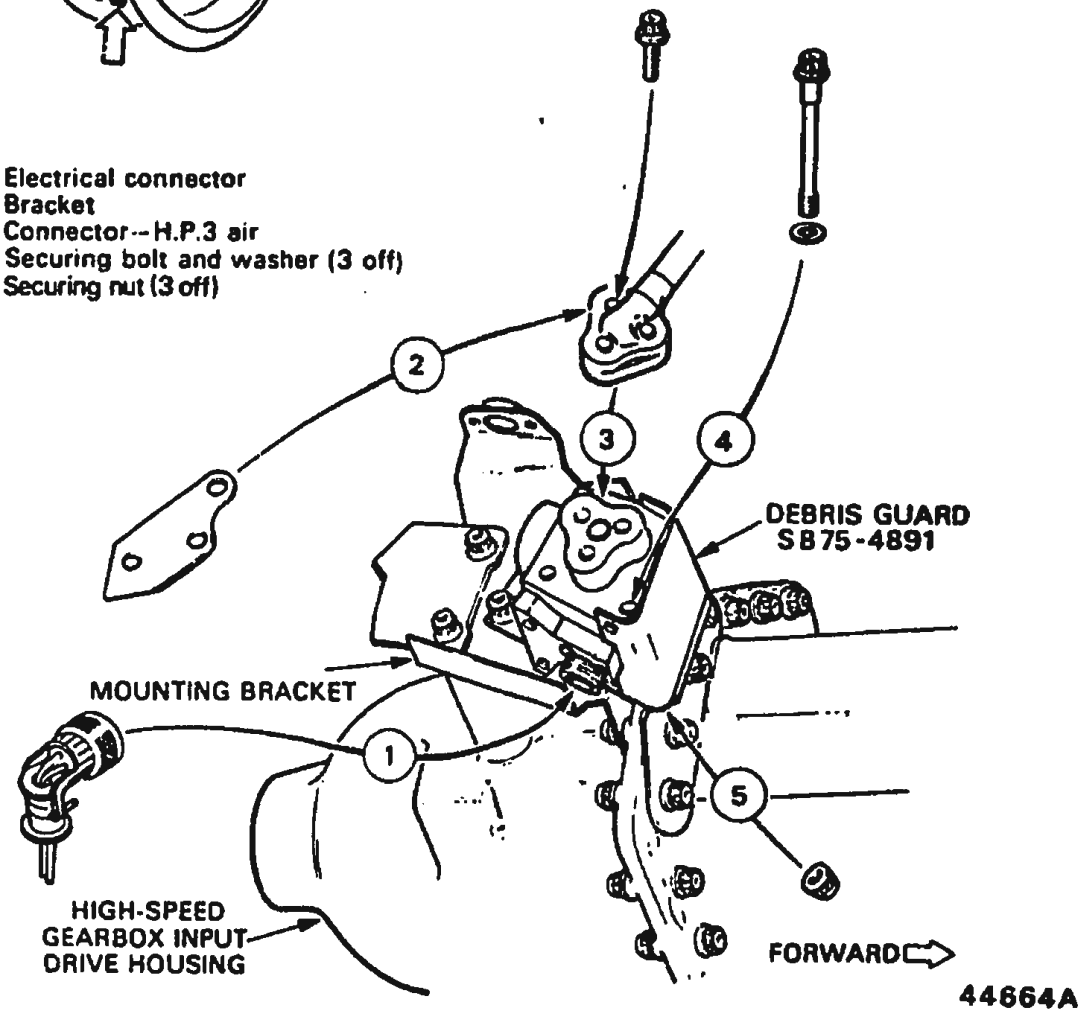
(8) Remove tags and close circuit breakers opened in operation A.(1).



R H.P. compressor bleed valve control unit removal/installation
R engines without S.B.76-4312 and S.B.75-5250)
R Fig.201

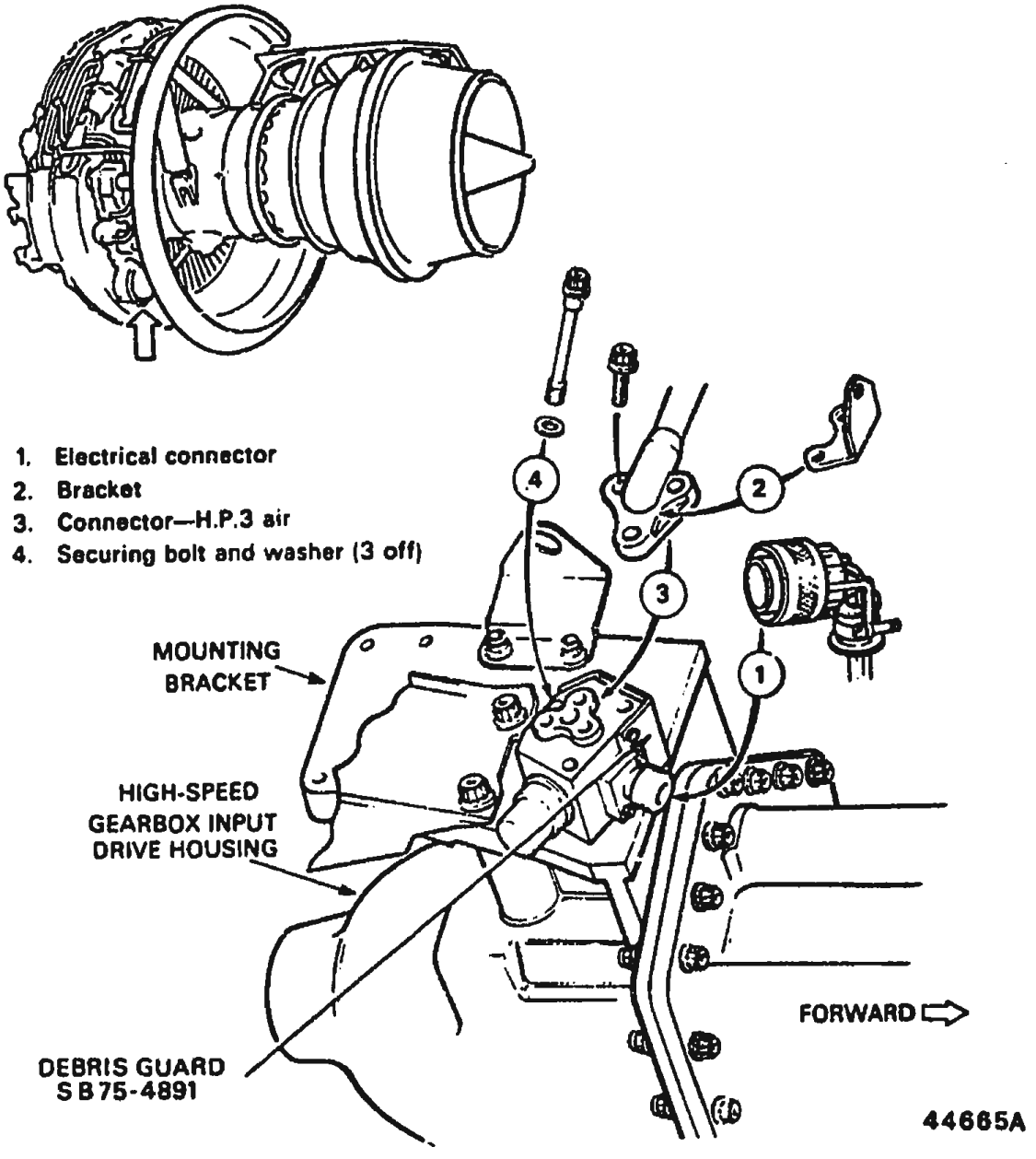


1. Electrical connector
2. Bracket
3. Connector--H.P.3 air
4. Securing bolt and washer (3 off)
5. Securing nut (3 off)



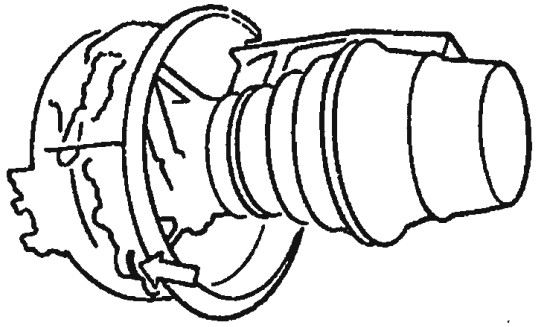
R H.P. compressor bleed valve control unit removal/installation
R (Non A.I.D.S. engines with S.B.75-5250)
R Fig.202

R EFFECTIVITY: ALL
R

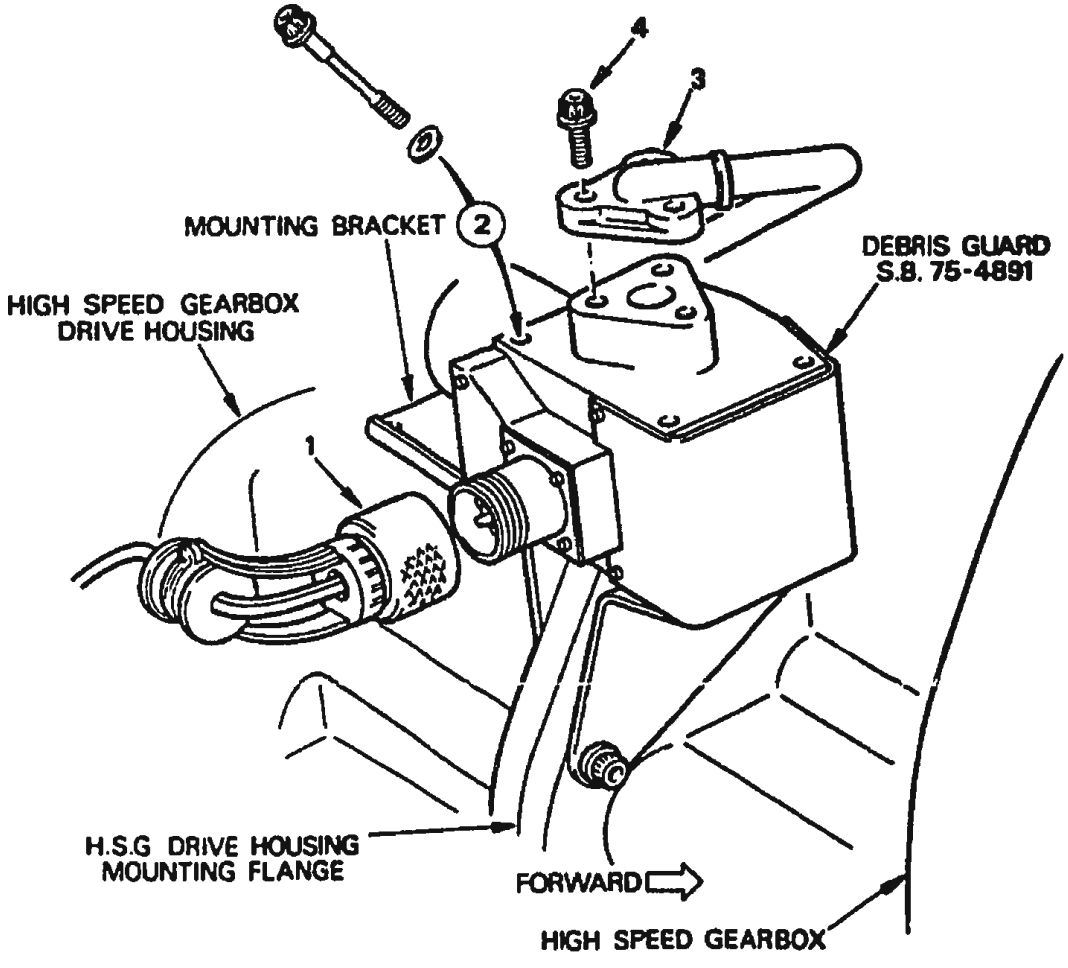


R H.P. compressor bleed valve control unit removal/installation
R (A.I.D.S. engines with S.B.76-4312 without S.B.75-5250)
R Fig.203

R EFFECTIVITY: ALL



1. Electrical connector
2. Solenoid securing bolt and washer
3. H.P.3 Air pipe
4. H.P.3 Air pipe securing bolt



R H.P. compressor bleed valve control unit removal/installation
R (A.I.D.S. engines with S.B.75-5250)
R Fig.204

R EFFECTIVITY: ALL

R 3. Adjustment/Test Compressor Bleed Valve Control Unit Solenoid
R -- Engines with S.B.71-5474

R A. Operational Test

R (1) Open applicable engine circuit breakers:

H.P. Fuel SOV	CB1	F16 or F17 or F18
B Ignition	CB1	F13 or F14 or F15
A Ignition	CB3	N6 or N12 or N18

R (2) Open L.H. hinged cowl 413A or 423A for engines No.1 and No.3 (Ref.71-11-00) or 433AL for engine No.2 (Ref.71-12-01).

R (3) Connect and energise external power system (Ref.24-41-00).

R (4) Set applicable engine H.P.3 bleed valve circuit breaker:

(CB1) E16 or E17 or E18

R (5) Place applicable Fuel/Ignition switch to 'ON' and check H.P.3 bleed valve solenoid clicks audibly.

R (6) De-energise and disconnect external power system (Ref.24-41-00).

R (7) Return Fuel/Ignition switch to 'OFF' and reset applicable circuit breakers.

R (8) Close L.H. hinged cowl 413A or 423A for engines No.1 and 3 (Ref.71-11-00) or 433AL for engine No.2 (Ref.71-12-01).

H.P. COMPRESSOR BLEED VALVE - MAINTENANCE PRACTICES

1. Removal/Installation H.P. Compressor Bleed Valves

WARNING: ENSURE THRUST REVERSER SYSTEM IS LOCKED IN FORWARD THRUST POSITION (REF. 78-30-00, SERVICING) WHILE WORK IS IN PROGRESS.

CAUTION: BLEED VALVES WITH YELLOW PAINTED CAP MUST ONLY BE FITTED IN THE UPPER RIGHT-HAND POSITION. THOSE WITHOUT YELLOW PAINTED CAP MUST ONLY BE FITTED IN THE LOWER LEFT-HAND POSITION.

A. Remove H.P. Compressor Left-hand Bleed Valve

CR NOTE: When cracking of the louvers is experienced, the
CR louvers should be removed instead of replacing the
CR duct assembly. Should replacement of the duct be
CR necessary, remove the louvers prior to installing
CR to prevent future cracking of the mounting lugs.

(1) Equipment required:

CP.20309 or XUT.37594 Working platform

(2) Tag throttle control levers and thrust reverser levers. Tag APU/GRD AIR TO REVERSERS switches.

(3) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag appropriate START AIR VALVE circuit breaker.

(4) Tag appropriate ENGINE START panel switchlights.

(5) On pilots overhead circuit breaker panel CB1, zone 210 or on Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, as appropriate, open and tag HP3 BLEED AIR circuit breaker.

(6) Position working platform in cold stream duct.

(7) Enter cold stream duct and remove compressor section L.H. rear gas generator fairing (Ref. 72-03-00, Removal/Installation).

(8) Refer to fig.201, remove bolts (1) and outer duct (2).

(9) Disconnect connector (3).

(10) Remove bolts (4), then remove bleed valve (5) and inner duct (6) from H.P. compressor case.

(11) Fit approved blanks to all exposed apertures and connectors.

B. Install H.P. Compressor Left-hand Bleed Valve

(1) Equipment required:

CP.20309 or XUT.37594 Working platform

(2) Ensure appropriate systems are tagged as detailed in operations A. (2) through (5).

(3) Ensure working platform is positioned in cold stream duct.

(4) Enter cold stream duct and remove blanks, if fitted, from all apertures and connectors.

(5) Refer to fig.201, position inner duct (6) on H.P. compressor case, ensuring bolts in duct and case are correctly aligned.

(6) Fit bleed valve (5) inside inner duct (6), ensuring correct location of connector (3) on bleed valve then secure valve and duct with bolts (4).

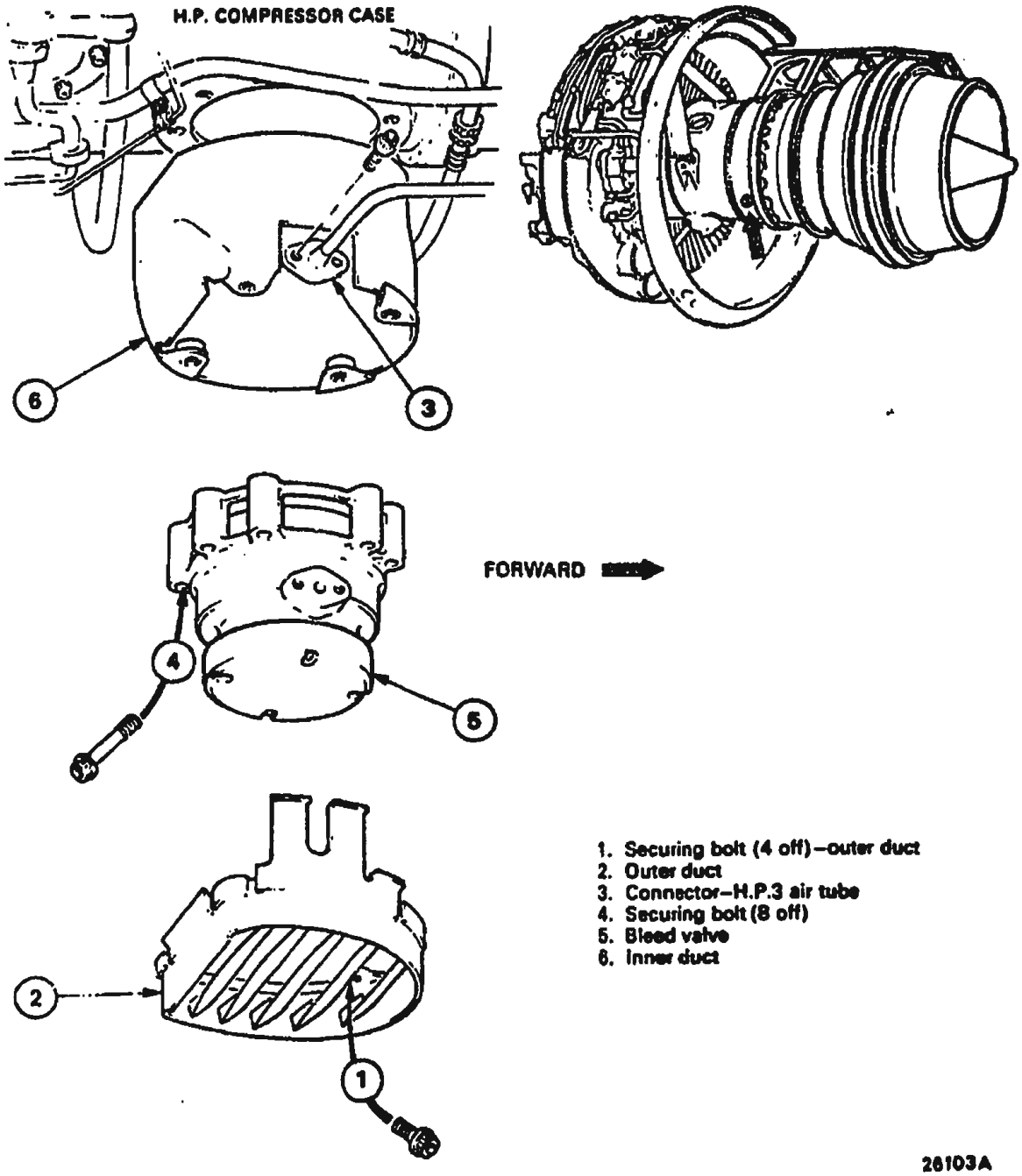
(7) Connect and secure connector (3).

(8) Position outer duct (2) on inner duct (6) then fit and secure bolts (1).

(9) Fit compressor section L.H. rear gas generator fairing (Ref. 72-03-00, Removal/Installation).

(10) Remove working platform.

(11) Remove tags and close circuit breakers opened in operations A. (2) through (5).



1. Securing bolt (4 off)—outer duct
2. Outer duct
3. Connector—H.P.3 air tube
4. Securing bolt (8 off)
5. Bleed valve
6. Inner duct

28103A

H.P. compressor left-hand bleed valve and duct removal/installation
Fig.201

C. Remove H.P. Compressor Right-hand Bleed Valve

(1) Equipment required:

CP.20309 or XUT.37594 Working platform

(2) Tag throttle control levers and thrust reverser levers. Tag APU/GRD AIR TO REVERSERS switches.

(3) On pilots overhead circuit breaker panel CB1, zone 210, open and tag appropriate THRUST REVERSE circuit breaker.

(4) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag appropriate START AIR VALVE circuit breaker.

(5) Tag appropriate ENGINE START panel switchlights.

(6) Position working platform in cold stream duct.

(7) Enter cold stream duct and remove compressor section R.H. rear gas generator fairing (Ref. 72-03-00, Removal/Installation).

(8) Refer to fig.202, remove bolts (1) and cover (2).

(9) Remove bolts (3) then remove bleed valve (4) and duct (5).

(10) Fit approved blanks to all exposed apertures and connectors.

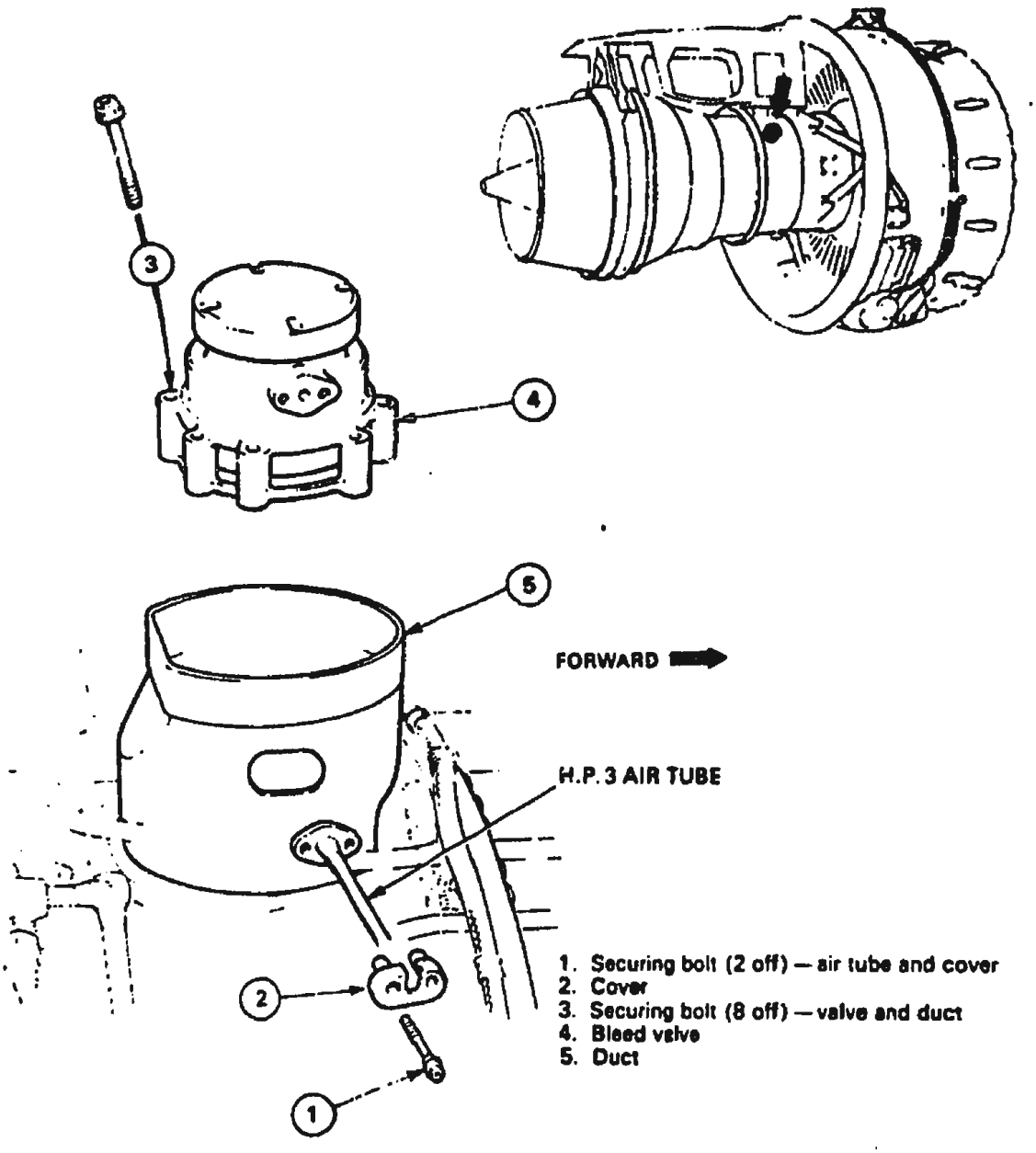
D. Install H.P. Compressor Right-hand Bleed Valve

(1) Equipment required:

CP.20309 or XUT.37594 Working platform

(2) Ensure appropriate systems are tagged as detailed in operations C. (2) through (5).

(3) Ensure working platform is positioned in cold stream duct.



H.P. compressor right-hand bleed valve and duct removal/installation
Fig.202

(4) Enter cold stream duct and remove blanks, if fitted, from all apertures and connectors.

(5) Refer to fig.202, enter air tube through slot in duct (5) and position duct on H.P. compressor case so that holes in duct and case are correctly aligned.

(6) Fit bleed valve (4) inside duct (5), ensuring air tube is correctly located on bleed valve then secure valve and duct with bolts (3).

On engines incorporating S.B.75-2248 - Baulking features for right-hand valve, and right-hand H.P. bleed valves incorporating Dunlop S.B.75-02 - Introduction of valve AC.65130 - fit bleed valve (4) inside duct (5), ensuring positive location of dowels in air tube connector and valve, then secure valve and duct with bolts (3).

(7) Seal slot in duct (5) with cover (2) then secure cover and air tube with bolts (1).

(8) Fit compressor section R.H. rear gas generator fairing (Ref. 72-03-00, Removal/Installation).

(9) Remove working platform.

(10) Remove tags and close circuit breakers opened in operations C. (2) through (5).

2. Inspection/Check

WARNING: ENSURE THRUST REVERSER SYSTEM IS LOCKED IN FORWARD THRUST POSITION (REF.78-30-00, SERVICING) WHILE WORK IS IN PROGRESS.

A. Inspect H.P. Compressor Right-hand Bleed Valve Duct

(1) Equipment required:

CP.20309 or XUT.37594 Working platform

(2) Tag throttle control levers and thrust reverser levers. Tag APU/GRD AIR TO REVERSERS switches.

(3) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag appropriate START AIR VALVE circuit breaker.

(4) Tag appropriate ENGINE START panel switchlights.

(5) On pilots overhead circuit breaker panel CB1, zone 210 or on Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, as appropriate, open and tag HP3 BLEED AIR circuit breaker.

(6) Position working platform in cold stream duct.

(7) Enter cold stream duct and remove compressor section R.H. rear gas generator fairing (Ref. 72-03-00, Removal/Installation).

C C (8) Inspect right-hand bleed valve duct for broken out or missing sections, cracks, dents, scores and nicks.

For acceptance standards see 2.B.

(9) Fit compressor section R.H. rear gas generator fairing (Ref. 72-03-00, Removal/Installation).

(10) Remove working platform.

(11) Remove tags and close circuit breakers opened in operations (2) through (5).

B. Acceptance Standards

C C (1) Broken out or missing sections - see 3. Approved Repairs.

C (2) Cracks - see 3. Approved Repairs.

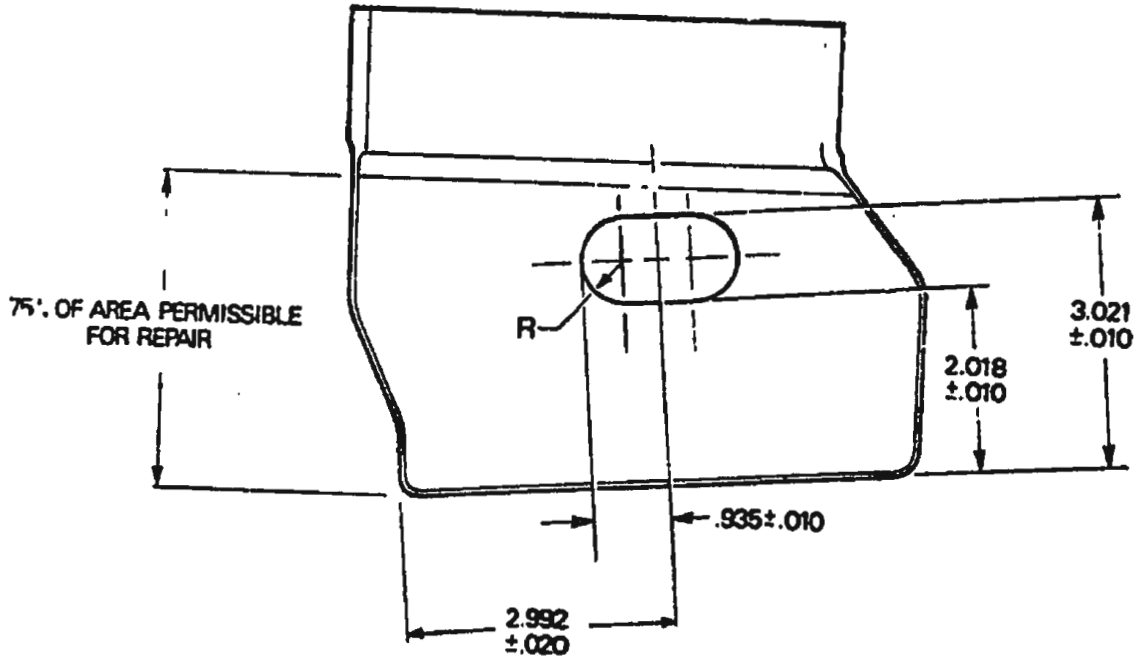
(3) Dents.

(a) Smooth dents providing they do not exceed 0.05in. (1,27 mm.) in depth and 0.75in. (19,05mm.) in length.

(b) The area within 0.50in. (12,70 mm.) of a weld or air tube slot must be free of all dents.

(4) Scores

(a) Scores providing they do not exceed 14 per cent of material thickness in depth and 1.00in. (25,40 mm.) in length and do not emanate from air tube slot.



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C H.P. compressor bleed valve duct repair limits
C Fig.203

(5) Nicks

(a) Nicks providing they do not emanate from air tube slot.

C 3. Approved Repairs

C A. Repair H.P. Compressor Bleed Valve Duct.

C (1) Cracks in bleed valve duct can be repaired as follows.

C (a) Penetrant check to determine extent of crack
C damage.

C (b) Clean both sides of repair area.

C (c) Weld up area of crack. Material is AISI 347.
C (No heat treat required).

C (d) Penetrant check for additional cracking after
C repair.

C (2) Broken out or missing sections may be repaired as
C follows.

C Limits - see figure 203.

C (a) Circumference - 25%.

C (b) Area between top thick section and bottom
C flange - 75%.

C (c) Penetrant check area around missing section for
C cracks. Repair cracks as in 1 above.

C (d) Locally fabricate piece to replace missing section
C from AISI 321/347 .062 sheet and butt weld new
C section into duct. (No heat treat required).

C (e) Penetrant check area for cracks.

C (f) Advise MCIMD, MCIEE that duct has been repaired
C by welding in new section and request that MCIMD
C schedule replacement of the duct at next layover
C where time and parts are available.

COMPRESSOR DELIVERY PRESSURE AIDS - DESCRIPTION AND OPERATION

1. General

The delivery pressures of the three compressors are sensed by transducers that provide electrical signals for input to the Aircraft Integrated Data System (AIDS).

The engine-mounted units (Ref. Fig. 1) of the system consist of three transducers mounted on brackets on the front face of the engine firewall at the upper right-hand position, zones 412, 422 and 432.

R On engines with RR SB77-4406,
R the transducer support brackets are mounted on anti-vibration bushes. Each bracket incorporates a dowel that is positioned to align with a detent in the flange of the transducer it provides mounting for. The pairing of each bracket and transducer in this manner prevents the inadvertant interchange of transducers during installation.

PF air is sensed by the low pressure (LP) compressor delivery pressure transducer through a tube that connects the unit to a disconnect point. PF is fed to the disconnect point through a tube that connects to the Integrated Engine Pressure Ratio (IEPR) Indicating System (Ref. 77-11-00).

P3 air is sensed by the (IP) compressor delivery pressure transducer through a tube that connects the unit to a tapping on the HP valve controller air supply (Ref. 36-11-00).

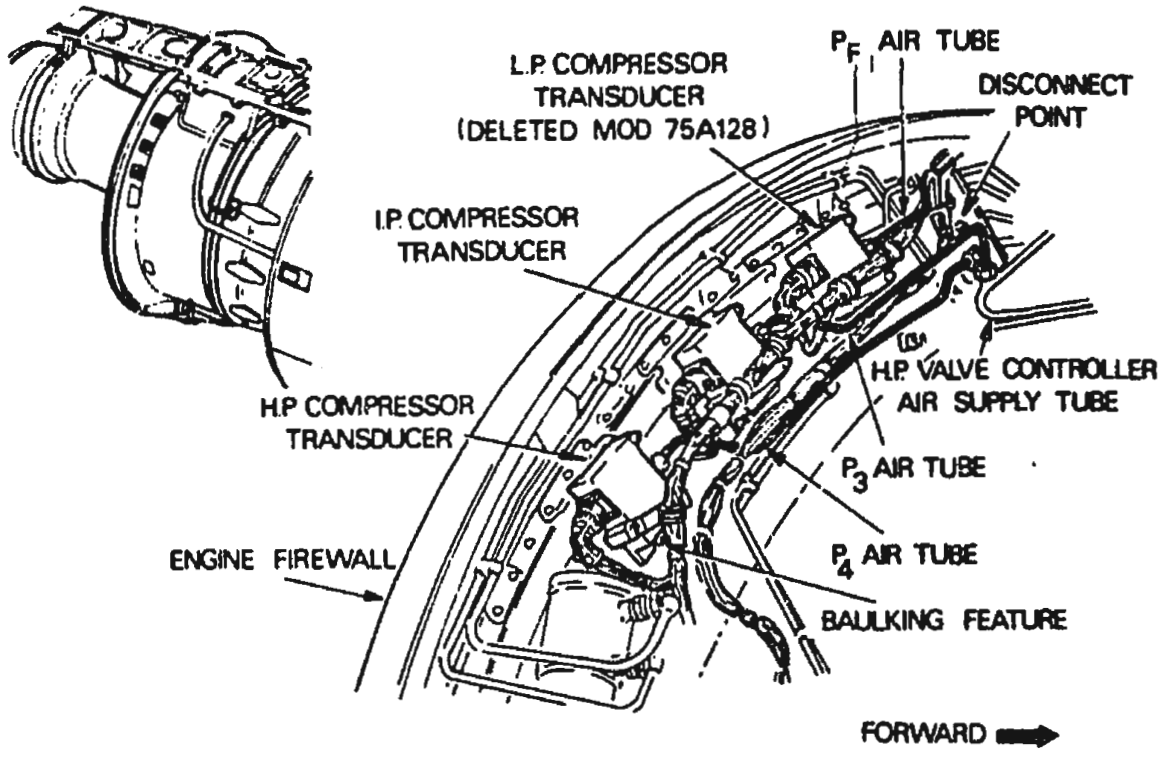
P4 air is sensed by the high pressure (HP) compressor delivery pressure transducer through a tube that connects the unit to the disconnect point. P4 is fed to the disconnect point through a tube that connects with a tapping on the combustion outer case.

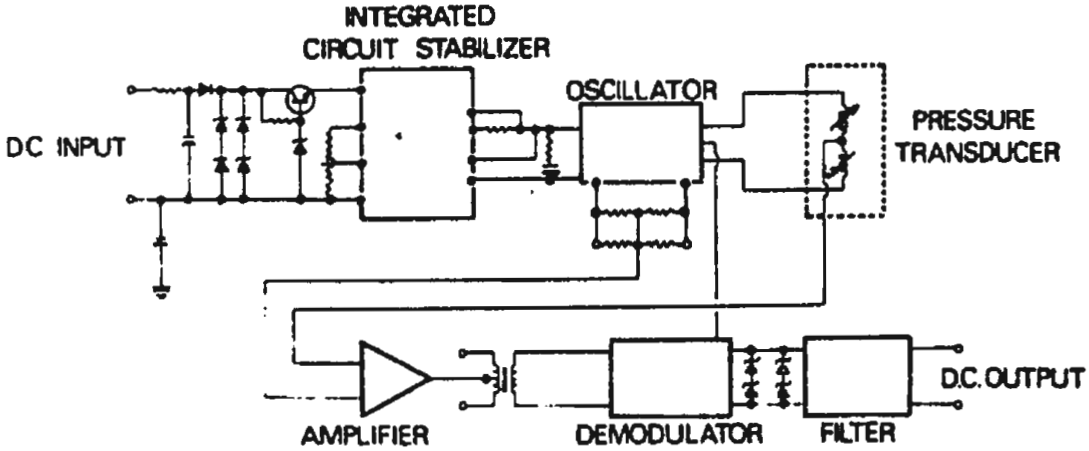
The pressure sensed by each transducer acts on one side of a diaphragm, deflection of which results in a dc voltage output. The output from each transducer is connected through the engine electrical harness and the aircraft electrical system to a data acquisition unit (Ref. 31-32-00).

2. Low-pressure Compressor Delivery Pressure Transducer

A. Description and Operation

The LP compressor delivery pressure transducer (Ref. Fig. 1) is mounted on the front face of the engine firewall at the upper right-hand position, zones 412, 422 and 432, and is





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Compressor Delivery Pressure AIDS Transducers and Circuit Diagram
Figure 1.

the uppermost of the three comrpessor delivery pressure transducers. A balking feature, in the form of a detent in the flange on the transducer, aligns with a dowel on the mounting bracket to ensure the transducer can only be fitted in the correct position on the firewall.

The transducer basically comprises a case which incorporates a pressure connector and an electrical receptacle. Housed within the case are a variable reluctance pressure transducer and an electronic assembly.

The variable reluctance pressure transducer basically comprises a metal diaphragm centrally disposed between two matched coils that are moulded into the core of a high permeability pot. The diaphragm and pot are encased between two end pieces incorporating drillings that direct PF air entering the pressure connector to one side of the diaphragm.

The electronic assembly basically comprises a stabilizer, oscillator, amplifier, demodulator and a filter.

The transducer receives a 28 volt dc supply from the aircraft electrical system. This supply is passed through the integrated circuit stabilizer to the oscillator. The oscillator converts the dc supply to ac and energizes the variable reluctance pressure transducer which forms part of a balanced bridge circuit. In the balanced state there is no output from the bridge circuit.

With the engine running, diaphragm deflection due to the air pressure acting on it, varies the reluctance of the two matched coils causing the bridge to unbalance. The resultant output, the phase and value of which are directly related to the LP compressor delivery pressure, is fed to the amplifier and then to the demodulator where it is converted to a dc voltage. This voltage is then passed through the filter and fed through external wiring to the data acquisition unit.

3. Intermediate-pressure Compressor Delivery Pressure Transducer

A. Description and Operation

The IP compressor delivery pressure transducer (Ref. Fig. 1) is mounted on the front face of the engine firewall on the upper RH side, zones 412, 422 and 432 and is the center of the three Compressor delivery pressure transducers.

The transducer is identical in construction and operation to the LP and HP compressor delivery pressure transducers

except for the operating pressure range and the position of the balking feature.

4. High-pressure Compressor Delivery Pressure Transducer

A. Description and Operation

The HP compressor delivery pressure transducer (Ref. Fig. 1) is mounted on the front face of the engine firewall at the upper right-hand position, zones 412, 422 and 432, and is the lower of the three compressor delivery pressure transducers.

The transducer is identical in construction and operation to the LP and IP compressor delivery pressure transducers except for the operating pressure range and the position of the balking feature.

LOW-PRESSURE COMPRESSOR DELIVERY PRESSURE TRANSDUCER REMOVAL AND INSTALLATION

1. Equipment and Materials

   Protective cap

   Blanking plate

   Lock-wire, Fed Spec QQ-W-390, 0.032-inch diameter, or equivalent

2. Referenced Procedures

70-51-00	Torque Technique - Maintenance Practices
71-11-00	Engines No. 1 and No. 3 Cowling - Servicing
71-12-05	LH and RH Upper Hinged Cowl - Servicing

3. Removal/Installation

   A. Removal

      (1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag circuit breaker AIDS/FLT RCDR DC (H10).

      (2) Open RH hinged cowl 414A or 424A for engine No. 1 or 3 (Ref. 71-11-00), or RH upper hinged cowl 434DR for engine No. 2 (Ref. 71-12-05).

R CAUTION: ENSURE ELECTRICAL CONNECTOR IS FREE FROM LIQUID AND/OR SOLID CONTAMINATION BEFORE DISCONNECTING.

      (3) Disconnect electrical connector from transducer (Ref. Fig. 401).

      (4) Disconnect PF tube connector from transducer.

      (5) Remove bolts, washers, and lug from upper bolt position.

R NOTE: On engines with RR SB77-2400 (Engine Indicating
R - Reclipping of AIDS harness around engine
R firewall),
R remove bolts, washers, and lug from upper bolt position then move harness bracket aside.

(6) Remove transducer from mounting bracket.

(7) Install approved blanking plate and protective cap on transducer.

B. Installation

(1) Verify that circuit breaker opened in Step 3A(1) is open and tagged.

(2) Remove protective cap and blanking plate from transducer.

(3) Install transducer on mounting bracket. With unit positioned as shown in Fig. 401, detent must be aligned with dowel when bolt holes are in line.

(4) Position lug at upper bolt position then install and secure bolts and washers.

R R NOTE: On engines with RR SB77-2400, position lug and washer at upper bolt position and harness bracket at lower bolt positions then install and secure bolts.

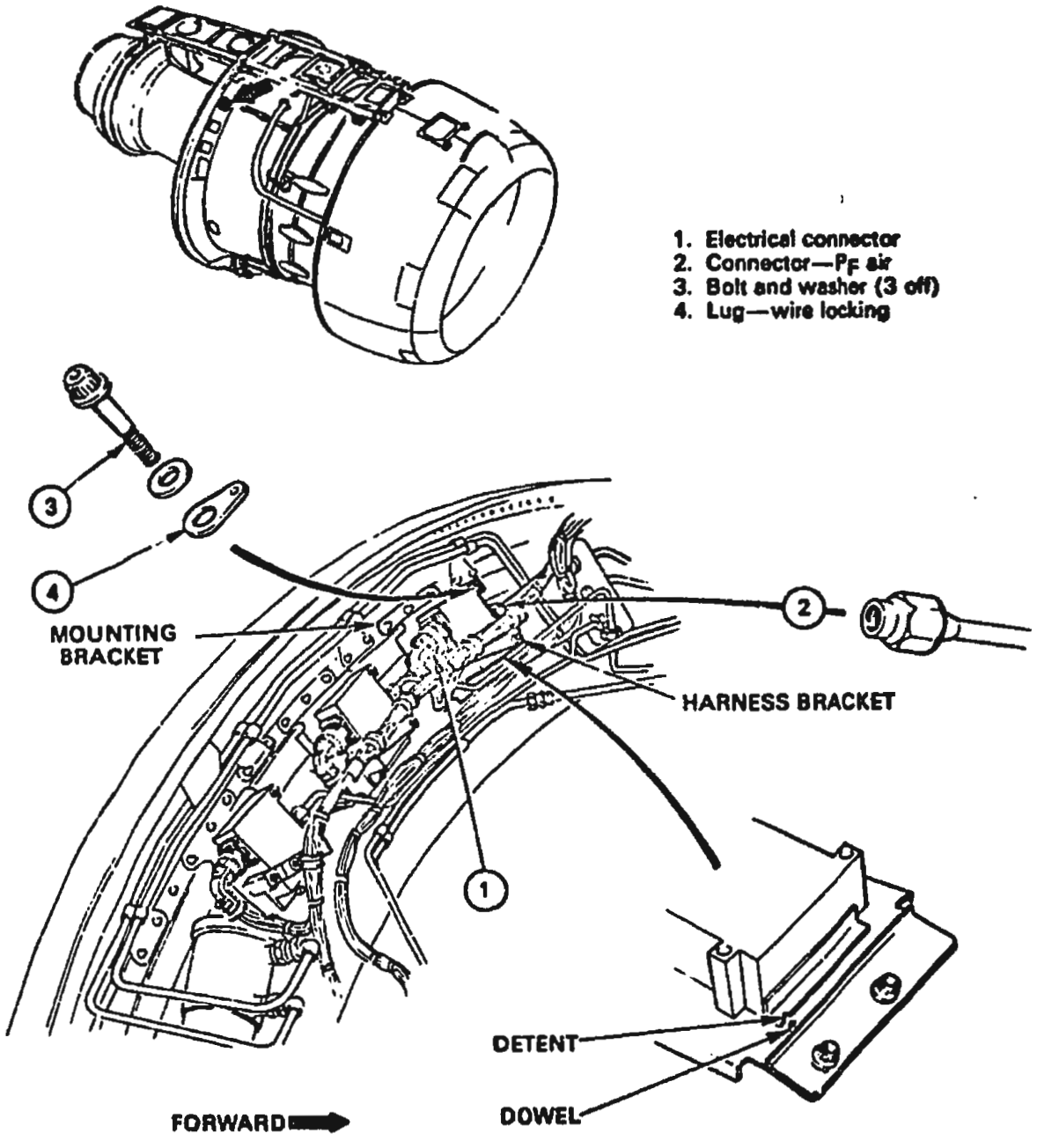
(5) Connect PF air connector to transducer (Ref. 70-51-00), and lock-wire to lug.

R CAUTION: ENSURE ELECTRICAL CONNECTOR IS FREE FROM LIQUID AND/OR SOLID CONTAMINATION BEFORE CONNECTING.

(6) Connect electrical receptacle connector to transducer.

(7) Remove tag and close circuit breaker opened in Step 3A(1).

(8) Close cowl (Ref. 71-11-00 or 71-12-05).



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LP Compressor Delivery Pressure Transducer
Removal and Installation
Figure 401

INTERMEDIATE-PRESSURE COMPRESSOR DELIVERY PRESSURE TRANSDUCER REMOVAL AND INSTALLATION

1. Equipment and Materials

   Protective cap

   Blanking plate

   Lock-wire, Fed Spec QQ-W-390, 0.032-inch diameter, or equivalent

2. Referenced Procedures

70-51-00	Torque Technique - Maintenance Practices
71-11-00	Engines No. 1 and No. 3 Cowling - Servicing
71-12-05	LH and RH Upper Hinged Cowl - Servicing

3. Removal/Installation

   A. Removal

      (1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag circuit breaker AIDS/FLT RCDR DC (H10).

      (2) Open RH hinged cowl 414A or 424A for engine No. 1 or 3 (Ref. 71-11-00), or RH upper hinged cowl 434DR for engine No. 2 (Ref. 71-12-05).

R CAUTION: ENSURE ELECTRICAL CONNECTOR IS FREE FROM LIQUID AND/OR SOLID CONTAMINATION BEFORE DISCONNECTING.

      (3) Disconnect electrical connector from IP (center) transducer (Ref. Fig. 401).

      (4) Disconnect P3 tube connector from transducer.

      (5) Remove bolts, washers, and lug from upper bolt position.

R NOTE: On engines with RR SB77-2400 (Engine Indicating
R - Reclipping of AIDS harness around engine
R firewall),
R remove bolts, washers, and lug from upper bolt position then move harness bracket aside.

(6) Remove transducer from mounting bracket.

(7) Install approved blanking plate and protective cap on transducer.

B. Installation

(1) Verify that circuit breaker opened in Step 3A(1) is open and tagged.

(2) Remove protective cap and blanking plate from transducer.

(3) Install transducer on mounting bracket. With unit positioned as shown in Fig. 401, detent must be aligned with dowel when bolt holes are in line.

(4) Position lug at upper bolt position then install and secure bolts and washers.

R R NOTE: On engines with RR SB77-2400, position lug and washer at upper bolt position and harness bracket at lower bolt positions then install and secure bolts.

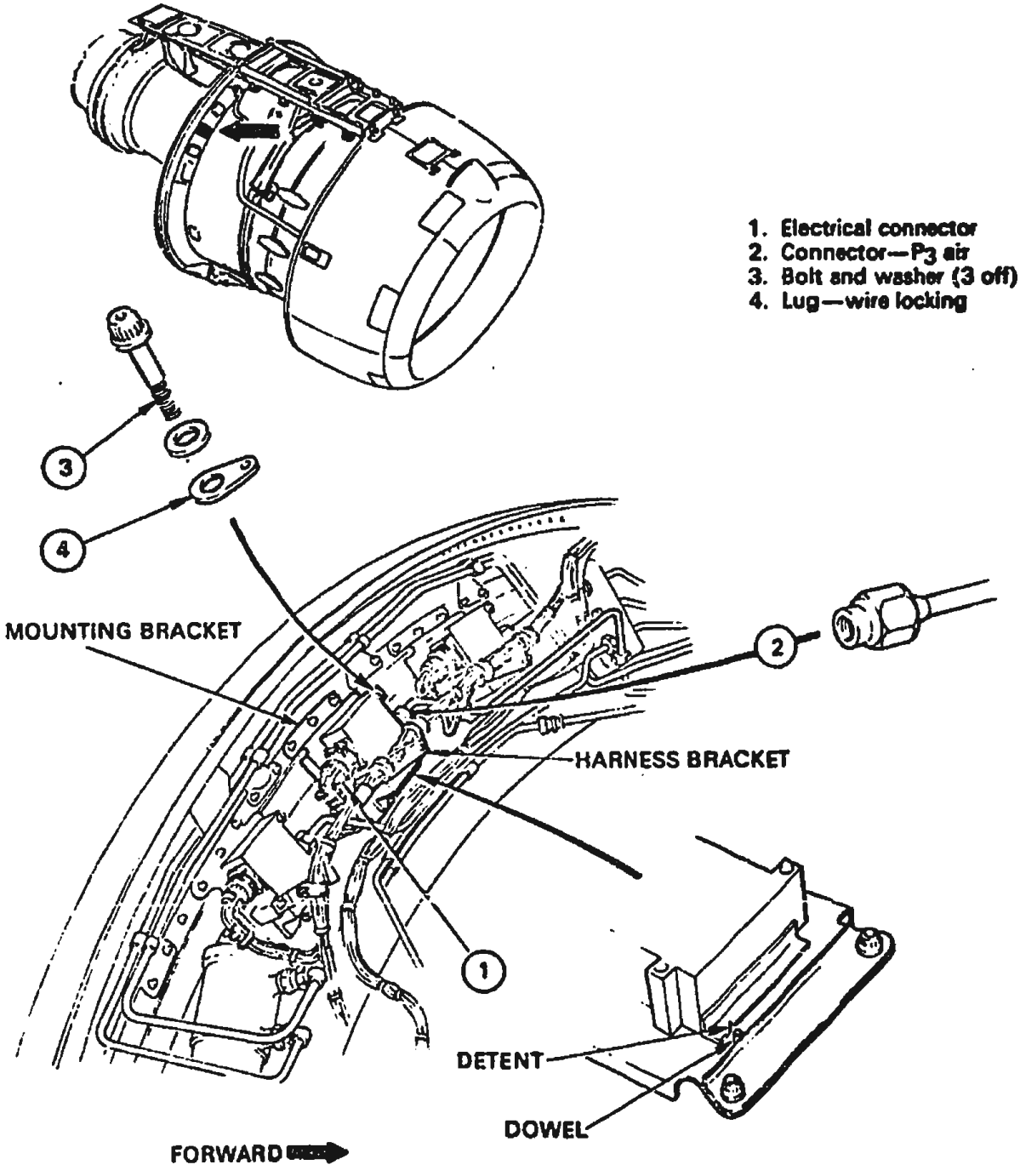
(5) Connect P3 air connector to transducer (Ref. 70-51-00), and lock-wire to lug.

R CAUTION: ENSURE ELECTRICAL CONNECTOR IS FREE FROM LIQUID AND/OR SOLID CONTAMINATION BEFORE CONNECTING.

(6) Connect electrical receptacle connector to transducer.

(7) Remove tag and close circuit breaker opened in Step 3A(1).

(8) Close cowl (Ref. 71-10-00 or 71-12-05).



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IP Compressor Delivery Pressure Transducer
Removal and Installation
Figure 401

HIGH-PRESSURE COMPRESSOR DELIVERY PRESSURE TRANSDUCER REMOVAL AND INSTALLATION

1. Equipment and Materials

   Protective cap

   Blanking plate

   Lock-wire, Fed Spec QQ-W-390, 0.032-inch diameter, or equivalent

2. Referenced Procedures

   70-51-00 Torque Technique - Maintenance Practices

   71-11-00 Engines No. 1 and No. 3 Cowling - Servicing

   71-12-05 LH and RH Lower Hinged Cowl - Servicing

3. Removal/Installation

   A. Removal

      (1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag circuit breaker AIDS/FLT RCDR DC (H10).

      (2) Open RH hinged cowl 414A or 424A for engine No. 1 or 3 (Ref. 71-11-00), or RH upper hinged cowl 434DR for engine No. 2 (Ref. 71-12-05).

R CAUTION: ENSURE ELECTRICAL CONNECTOR IS FREE FROM LIQUID AND/OR SOLID CONTAMINATION BEFORE DISCONNECTING.

      (3) Disconnect electrical connector from transducer (Ref. Fig. 401).

      (4) Disconnect P4 tube connector from transducer.

      (5) Remove bolts, washers, and lug from upper bolt position.

R NOTE: On engines with RR SB77-2400 (Engine Indicating
R - Reclipping of AIDS harness around engine
R firewall),
R remove bolts, washers, and lug from upper bolt position then move harness bracket aside.

(6) Remove transducer from mounting bracket.

(7) Install approved blanking plate and protective cap on transducer.

B. Installation

(1) Verify that circuit breaker opened in Step 3A(1) is open and tagged.

(2) Remove protective cap and blanking plate from transducer.

(3) Install transducer on mounting bracket. With unit positioned as shown in Fig. 401, detent must be aligned with dowel when bolt holes are in line.

(4) Position lug at upper bolt position then install and secure bolts and washers.

R
R NOTE: On engines with RR SB77-2400, position lug and washer at upper bolt position and harness bracket at lower bolt positions then install and secure bolts.

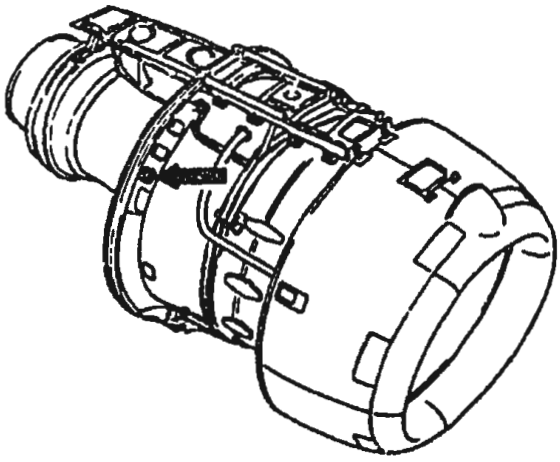
(5) Connect P4 air connector to transducer (Ref. 70-51-00), and lock-wire to lug.

R CAUTION: ENSURE ELECTRICAL CONNECTOR IS FREE FROM LIQUID AND/OR SOLID CONTAMINATION BEFORE CONNECTING.

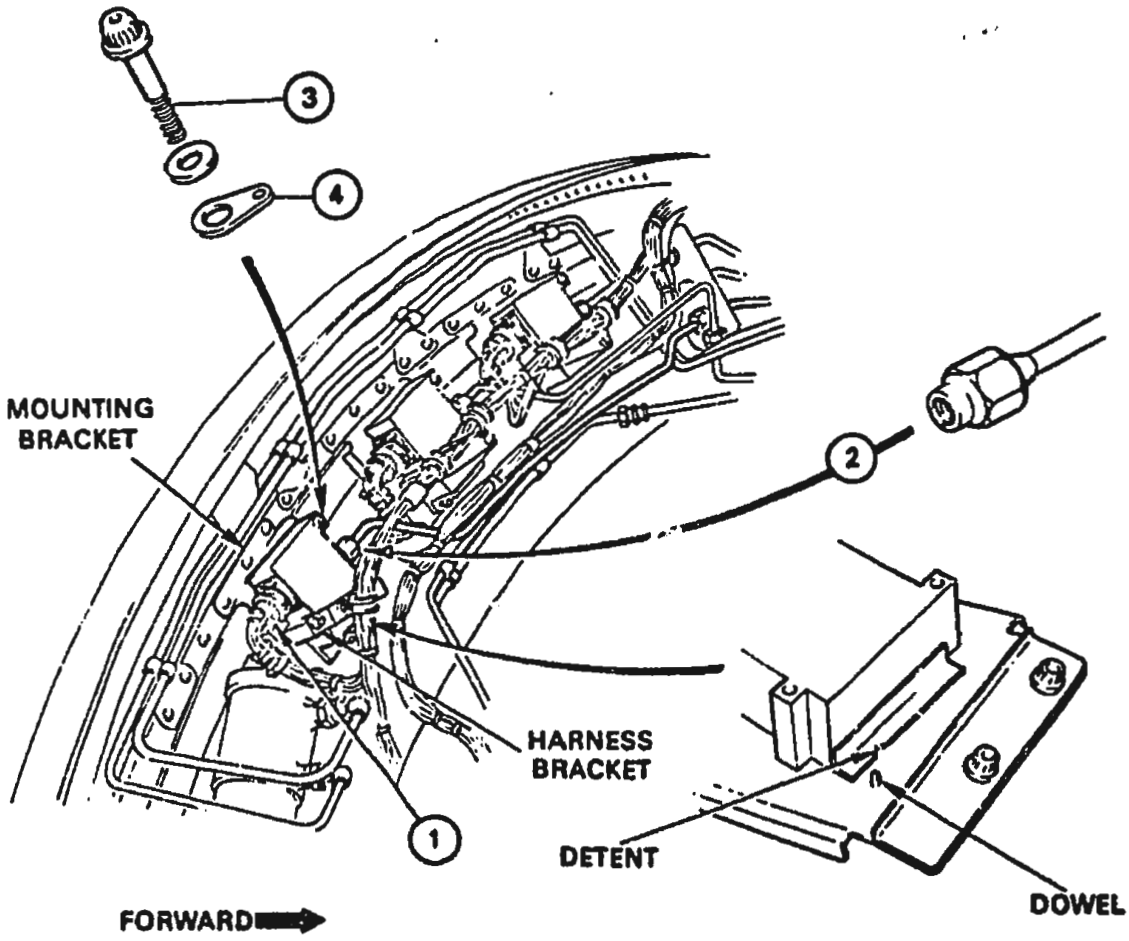
(6) Connect electrical receptacle connector to transducer.

(7) Remove tag and close circuit breaker opened in Step 3A(1).

(8) Close cowl (Ref. 71-11-00 or 71-12-05).



1. Electrical connector
2. Connector—P_3 air
3. Bolt and washer (3 off)
4. Lug—wire locking



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25480A

HP Compressor Delivery Pressure Transducer
Removal and Installation
Figure 401

COMPRESSOR DELIVERY TEMPERATURE AIDS - DESCRIPTION AND OPERATION

1. General

The temperature of the intermediate-pressure (IP) and high-pressure (HP) compressor delivery air, T3 and T4 respectively, is continually sensed by thermocouples. These supply electrical signals, proportional to the air temperature, into the airborne integrated data system (AIDS).

The engine-mounted units of the system (Ref. Fig. 1), located in zones 412, 422 and 432, consist of two thermocouples and associated electrical leads. One thermocouple is positioned in No. 8 strut of the intermediate case and the other is positioned on the combustion outer case at the upper RH side.

Air inlet and outlet holes in No. 8 strut of the intermediate case are so positioned to allow IP compressor delivery air to flow across the element of the T3 thermocouple.

The T4 thermocouple has an air inlet and outlet hole, which face downstream, to allow the HP compressor delivery air to flow across the element of the thermocouple.

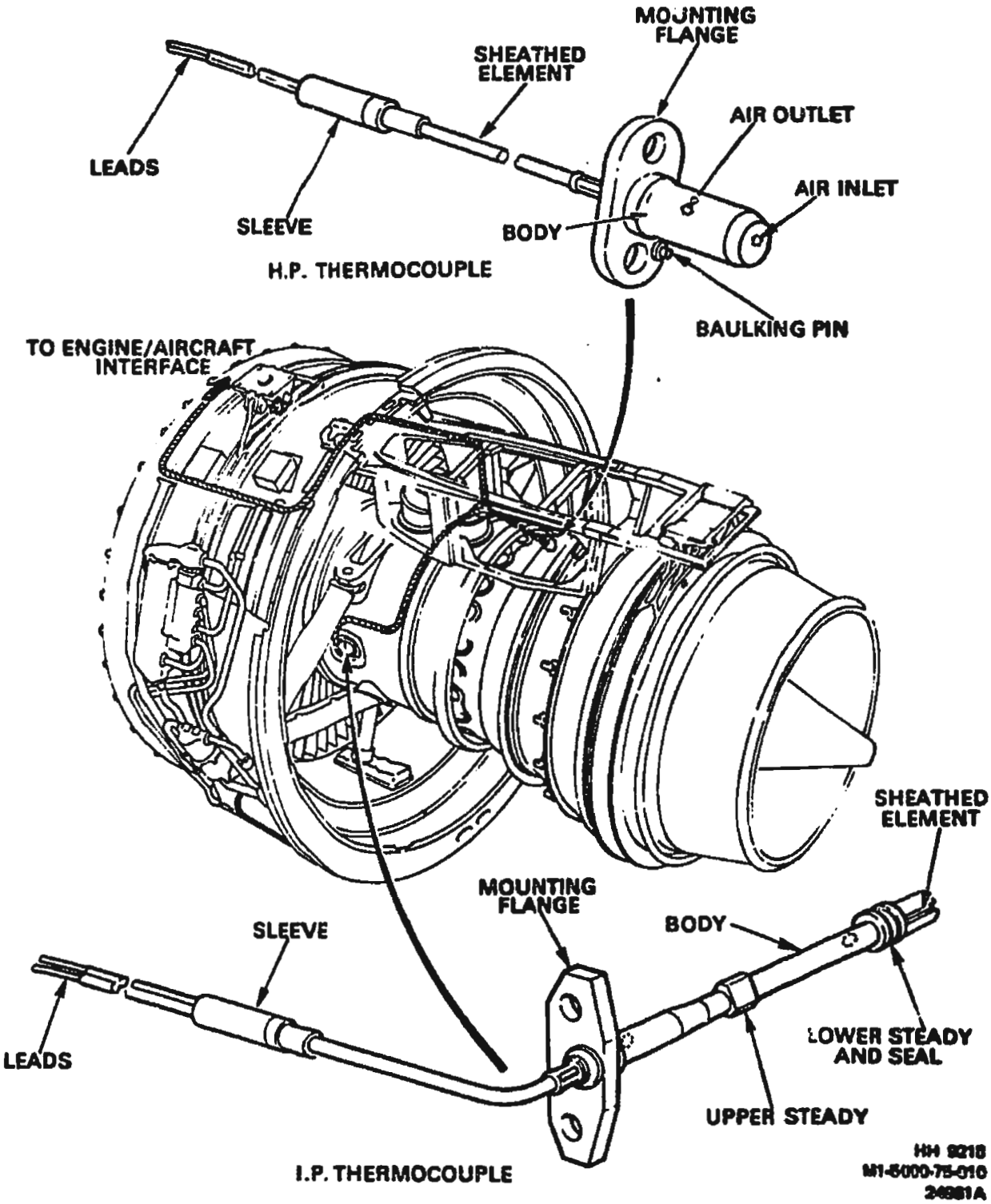
The electrical output of each thermocouple is distributed, through the engine electrical harness (Ref. 71-50-00), to the aircraft electrical system, and finally to the AIDS recorder (Ref. 31-31-00).

2. Intermediate-pressure Compressor Delivery Temperature Thermocouple

A. Description and Operation

The intermediate-pressure (IP) compressor delivery temperature thermocouple (Ref. Fig. 1), is fitted in No. 8 strut on the LH side of the intermediate case, zones 412, 422 and 432.

The thermocouple consists of a nickel-chromium/nickel-aluminum element enclosed in a sheath. That unit is centrally located in a metal body which is attached to a mounting flange. The body is attached to the flange off-center to ensure that the thermocouple can only be fitted one way. The element conductors are insulated from each other and from the sheath.



Compressor Delivery Temperature AIDS Thermocouples
Figure 1

A slot at the lower end of the body allows hot air to flow over the junction of the sheathed element. Two guides (steadies) on the body centralize and locate the thermocouple in the intermediate case strut. The lower steady also incorporates an air seal.

The sheathed element extends from the mounting flange to a connecting sleeve where flexible leads are attached to the element conductors.

Hot air from the IP compressor delivery, flowing over the junction of the thermocouple element causes a voltage to be produced proportional to the air temperature.

3. High-pressure Compressor Delivery Temperature Thermocouple

A. Description and Operation

The high-pressure (HP) compressor delivery temperature thermocouple (Ref. Fig. 1) is fitted on the combustion outer case at the upper RH side, zones 412, 422 and 432. The thermocouple is fitted so that it protrudes into the delivery airstream, and a baulking pin ensures that the air inlet and outlet holes of the thermocouple face downstream.

The thermocouple is similar in construction to the IP temperature thermocouple (Ref. Para. 2) except that the steel body completely encloses the element. An air inlet hole is positioned on a chamfered edge at the lower end of the body and an air outlet hole is positioned approximately half way up the body.

Hot air, from the HP compressor delivery, flows through the inlet hole, over the junction of the thermocouple element then through the outlet hole. The voltage produced in the element is proportional to the air temperature.

IP AND HP COMPRESSOR DELIVERY TEMPERATURE THERMOCOUPLE REMOVAL AND INSTALLATION

1. Equipment and Materials

Splitter Area Access Work Platform, Rolls-Royce Ltd., PN CP20309, or XUT. 37594, or XUT. 42526 Spacer and XUT. 42527 Side Piece, or equivalent

Plastic protective caps

2. Referenced Procedures

72-03-00 Gas Generator Fairings - Removal and Installation

78-30-00 Thrust Reverser - Servicing

3. Removal/Installation

R WARNING: ENSURE THRUST REVERSER SYSTEM IS LOCKED IN FORWARD THRUST POSITION WHILE WORK IS IN PROGRESS.

A. Removal

(1) Lock thrust reverser system in forward-thrust position (Ref. 78-30-00).

(2) On pilots overhead circuit breaker panel CB1, zone 210, open and tag applicable circuit breaker ENGINE START CONT (E13, E14, or E15).

(3) Place the splitter area access work platform in the cold-stream exhaust collector nozzle.

R (4) On engines without RR SB 72-3310, remove interservices fairing nose section R.H. access panel, compressor section L.H. and R.H. upper fairing, compressor section L.H. rear fairing, and combustion section upper fairing (Ref. 72-03-00).

R (4) On engines with RR SB72-3310, remove access panels as follows (Ref. 72-03-00):

(a) Compressor Section Upper RH Fairing 412AR or 822AR for engines No. 1 and 3 or 432AR for engine No. 2.

(b) Compressor Section Rear RH Fairing 412FR or 422FR for engines No. 1 and 3 or 432FR for engine No. 2.

(c) IP/HP Duct Access Panel 418AL or 428AL for engines No. 1 and 3 or 438AL for engine No. 2.

(5) Disconnect AIDS light duty (LD) harness (Ref. Fig. 401) from electrical receptacle (1).

(6) Remove screws and nuts (2).

R (7) On engines without RR SB72-3310, remove bolts (3) and extract IP thermocouple.

R (7) On engines with RR SB72-3310, remove bolts (3) and extract IP thermocouple, then remove spacer (4).

R (8) On engines without RR SB72-3310, remove bolts (4) and extract HP thermocouple.

R (8) On engines with RR SB72-3310, remove bolts (5) and extract HP thermocouple.

R (9) On engines without RR SB75-3058 or RR SB72-3310, release clips (1) through (12) then remove harness and thermocouple assembly (Ref. Fig. 402, View A).

R (9) On engines with RR SB75-3058, release clips (1) through (6) and (10) through (14) (Ref. Fig. 402, View B).

R (9) On engines with RR SB72-3310, release clips (1) through (9) (Ref. Fig. 402).

R (10) On engines without RR SB72-3310, remove harness and thermocouple assembly.

R (10) On engines with RR SB72-3310, release clips (1) through (3) (Ref. Fig. 403) then remove harness and thermocouple assembly.

(11) Cap all exposed openings and connectors.

B. Installation

(1) Verify that thrust reverser system is locked in forward-thrust position (Ref. 78-30-00).

(2) Verify that circuit breaker opened in Step 3A(2) is open and tagged.

(3) Verify that work platform installed in Step 3A(3) is in place.

(4) Remove caps from openings and connectors.

R (5) On engines without RR SB75-3058 or RR SB72-3310, Position harness and thermocouple assembly on engine (Ref. Fig. 402, View A).

R (5) On engines with RR SB75-3058, position harness and thermocouple assembly on engine (Ref. Fig. 402, View B).

R (5) On engines with RR SB72-3310, position harness and thermocouple assembly on engine (Ref. Fig. 402 and 403).

R (6) On engines without RR SB72-3310, insert HP thermocouple, ensuring positive location of baulking pin then install and secure bolts (4) (Ref. Fig. 401).

R (6) On engines with RR SB72-3310, insert HP thermocouple, ensuring positive location of baulking pin, then install and secure bolts (5).

R (7) On engines without RR SB72-3310, insert IP thermocouple then install and secure bolts (3).

R (7) On engines with RR SB72-3310, position spacer (4) on engine and insert IP thermocouple, then install and secure bolts (3).

(8) Position electrical receptacle (1) on interservices fairing floor then install and secure screws and nuts (2).

R (9) On engines without RR SB72-3310, secure harness clips (Ref. Fig. 403).

R (9) On engines with RR SB72-3310, secure harness clips (1) through (3) (Ref. Fig. 403), then secure harness clips (1) through (9) (Ref. Fig. 402).

R (10) On engines without RR SB72-3310, connect AIDS light duty harness to receptacle.

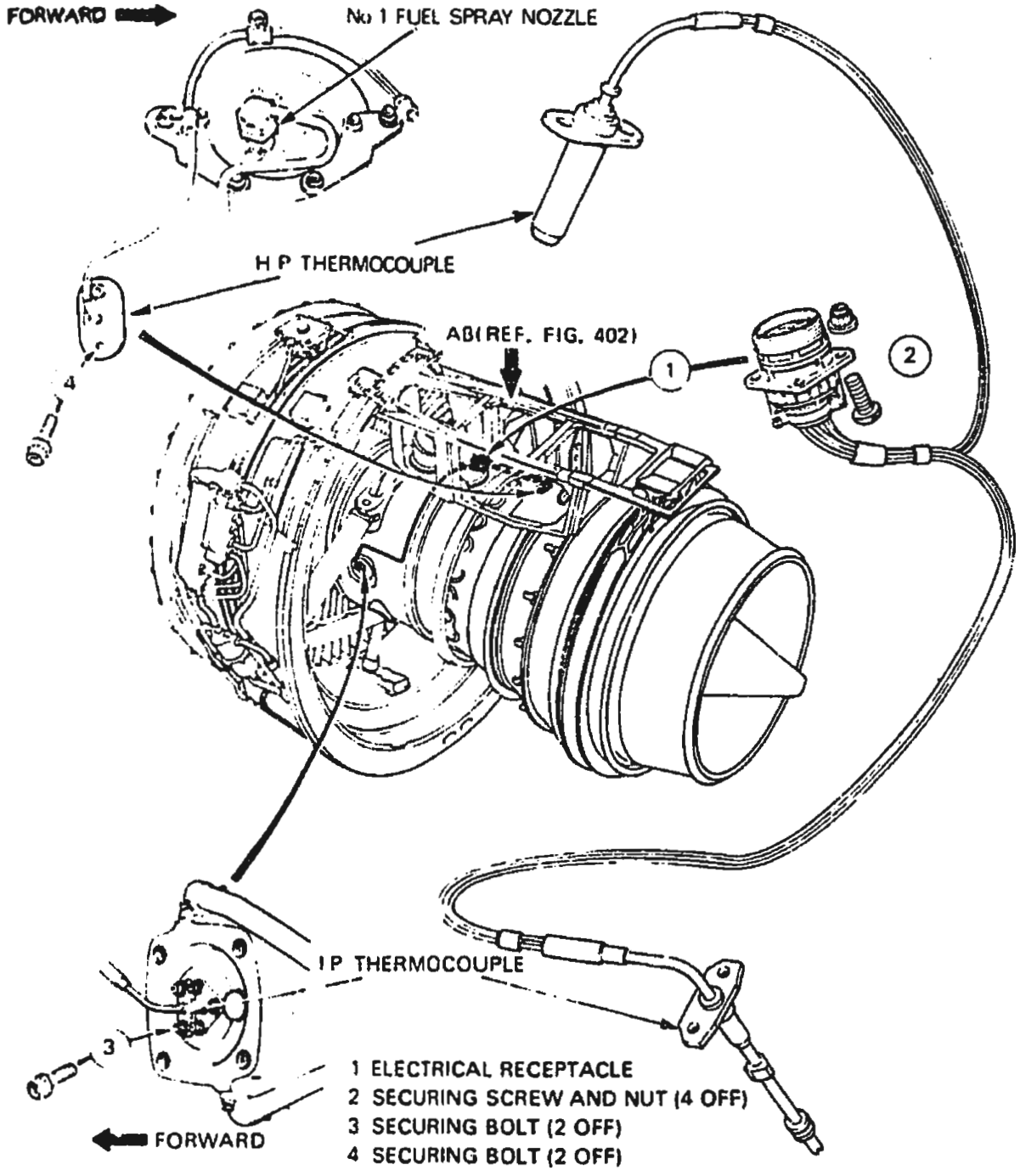
R (10) On engines with RR SB72-3310, connect and secure AIDS Zone 2LD harness to electrical receptacle (1) (Ref. Fig. 401).

(11) Install fairings and panels removed in Step 3A(4).

(12) Remove splitter area access work platform.

(13) Unlock thrust reverser system (Ref. 78-30-00).

(14) Remove tags and close circuit breakers opened in Step 3A(2).



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IP and HP Compressor Thermocouple - Removal and Installation
Figure 401

R EFFECTIVITY: ENGINES WITHOUT RR SB72-3310
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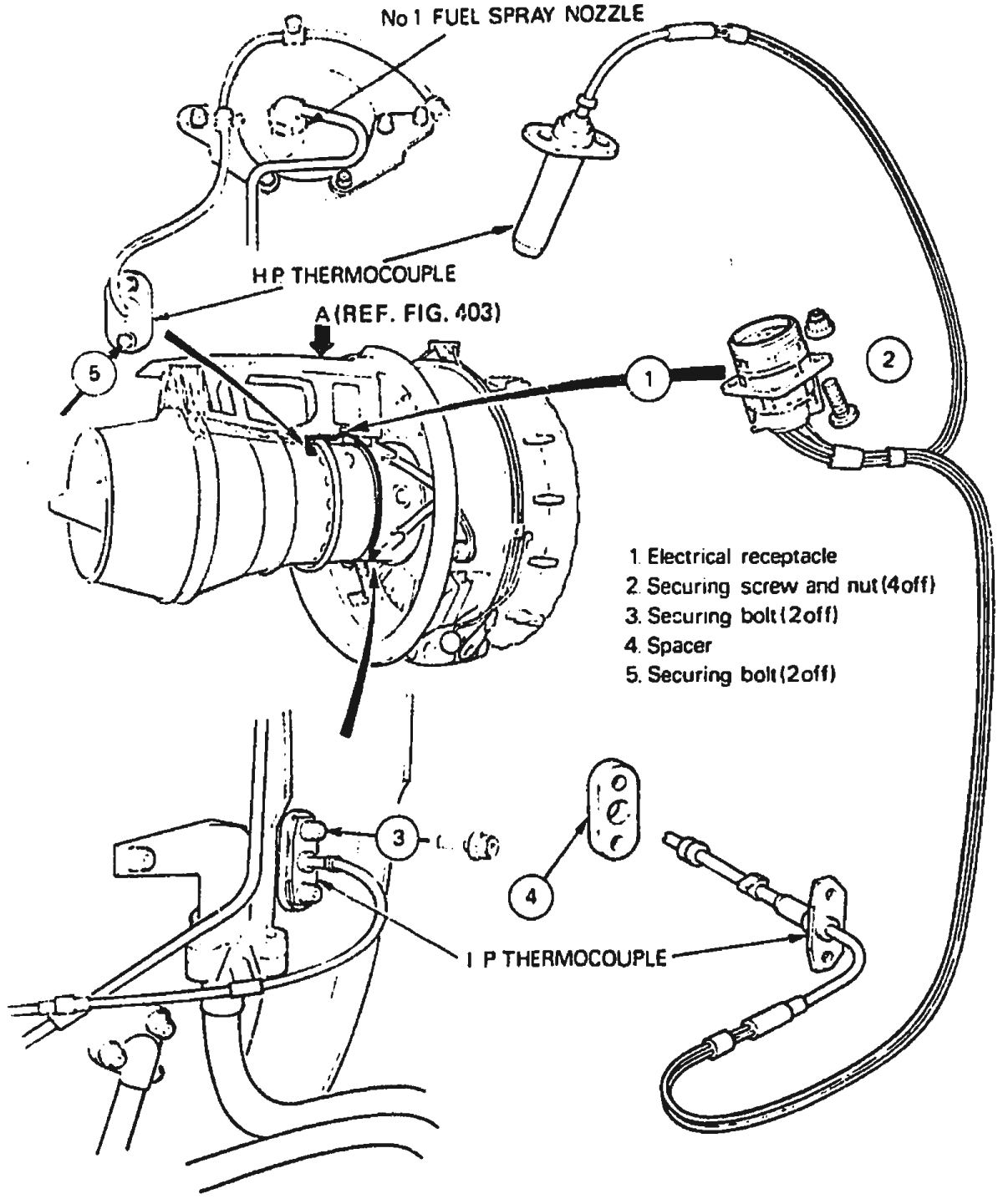

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IP and HP Compressor Thermocouple - Removal and Installation
Figure 401

R
R
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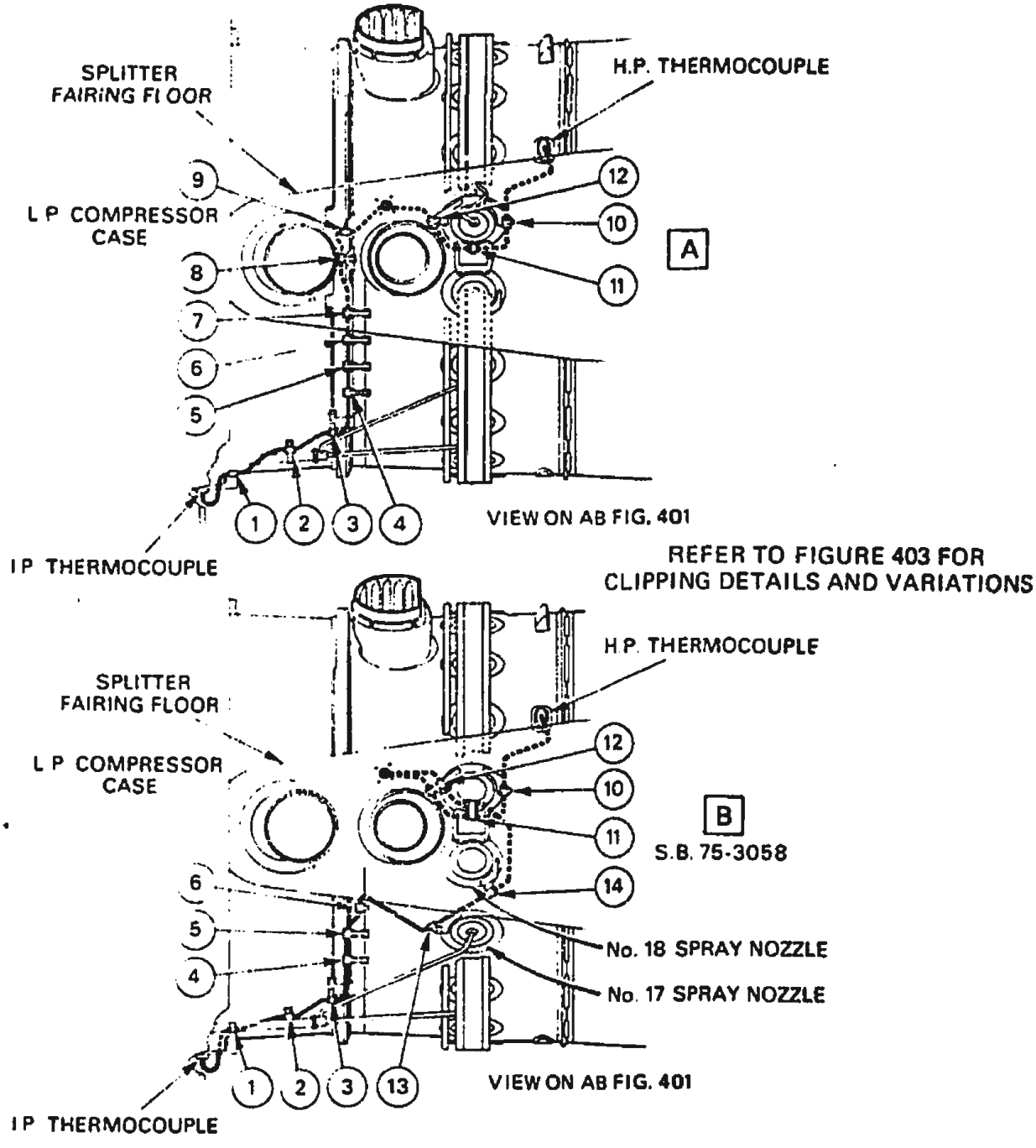
EFFECTIVITY: ENGINES WITH RR SB72-3310

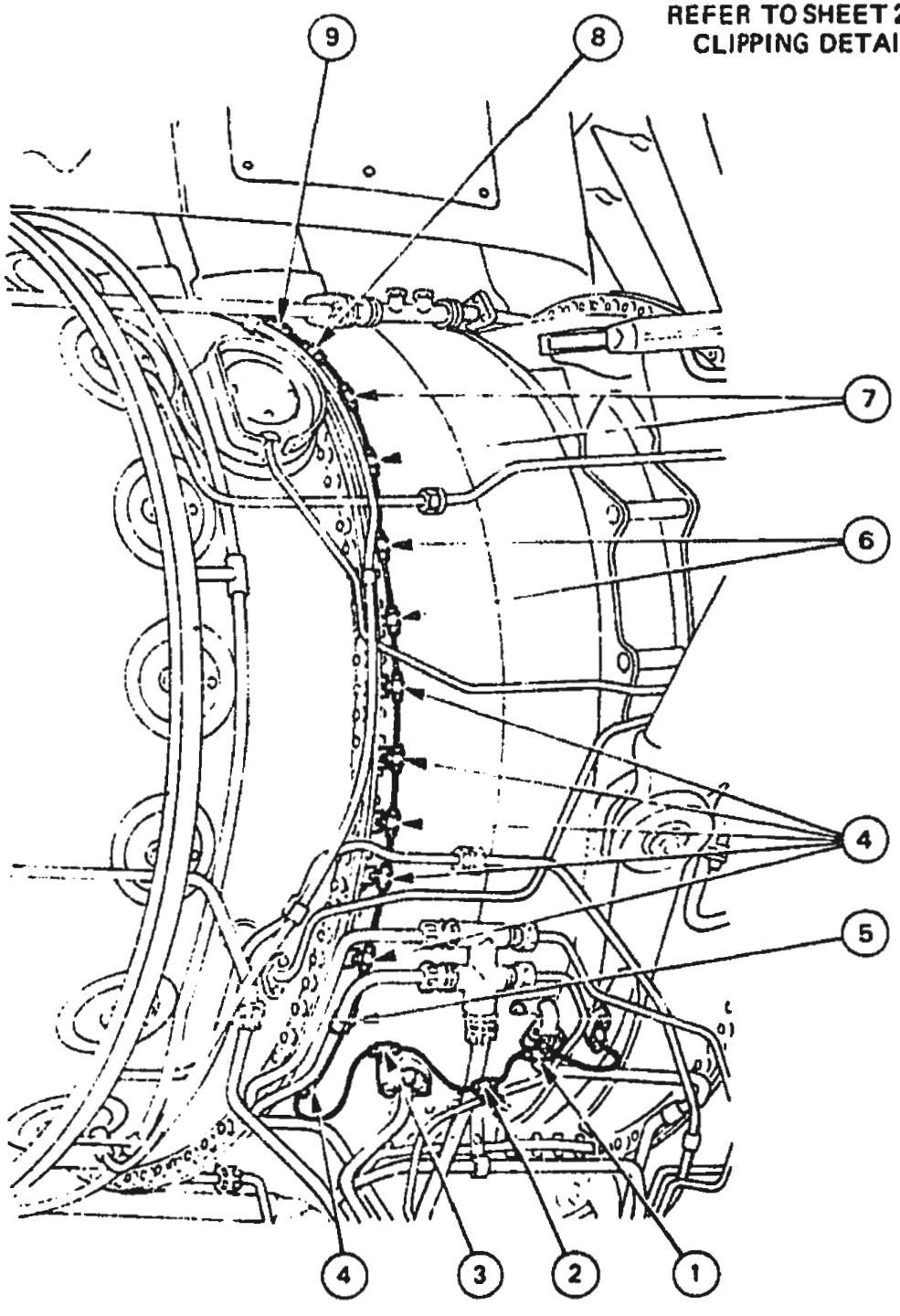


30670
M1-51001-75-412

Thermocouple Harness Disconnect Points
Figure 402

R
R
001R

EFFECTIVITY: ENGINES WITHOUT RR SB72-3310



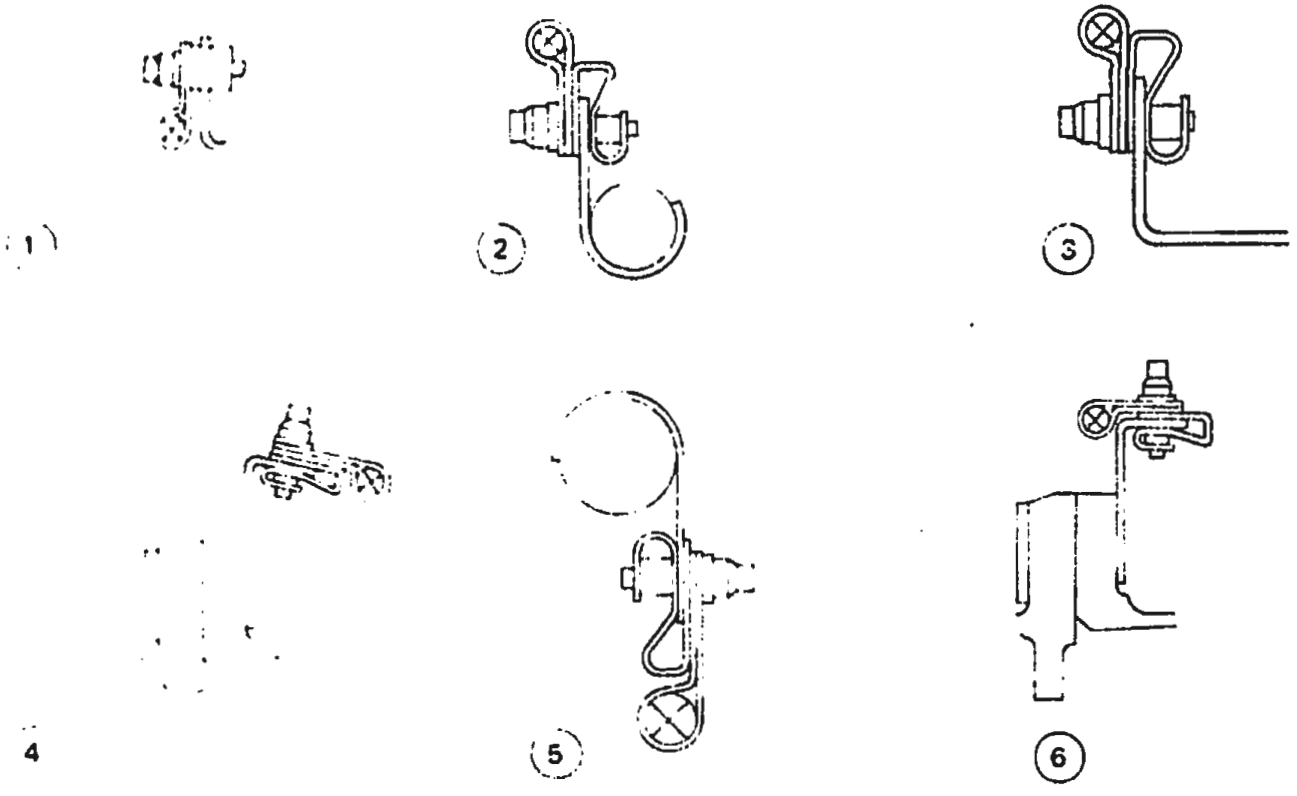
32563
M1-51000-75-416

Thermocouple Harness Disconnect Points and Securing Clip Details
Figure 402 (Sheet 1)

R
R
001A

EFFECTIVITY: ENGINES WITH RR SB72-3310

NUMBERS REFER TO CLIP POSITIONS SHEET 1



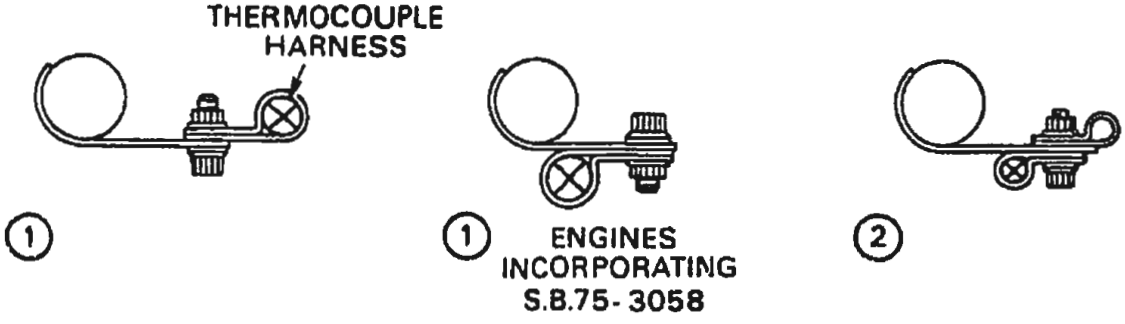
32665
M1-51000-75-417

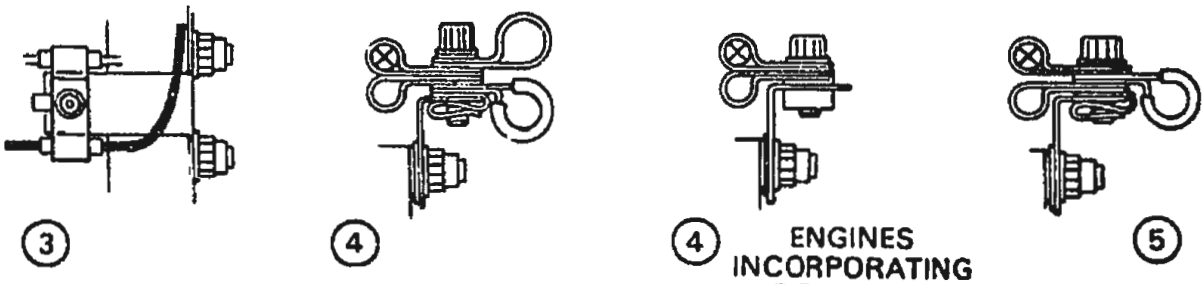
Thermocouple Harness Disconnect Points and Securing Clip Details
Figure 402 (Sheet 2)

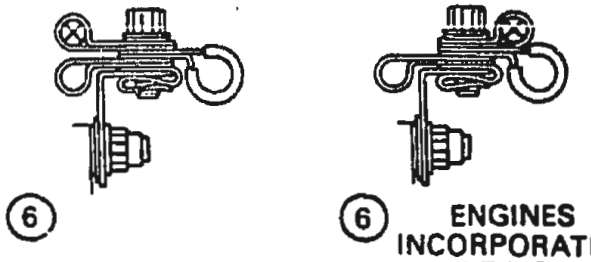
R
R
0018

EFFECTIVITY: ENGINES WITH RR SB72-3310

NUMBERS REFER TO CLIP POSITIONS FIGURE 402







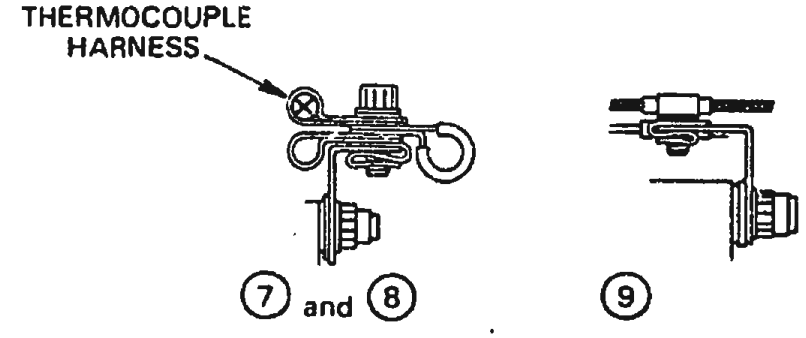
M1-5000-75-413
30671

Thermocouple Harness Securing Clip Details
Figure 403 (Sheet 1)

R
R
001R

EFFECTIVITY: ENGINES WITHOUT RR SB72-3310

NUMBERS REFER TO CLIP POSITIONS FIGURE 402

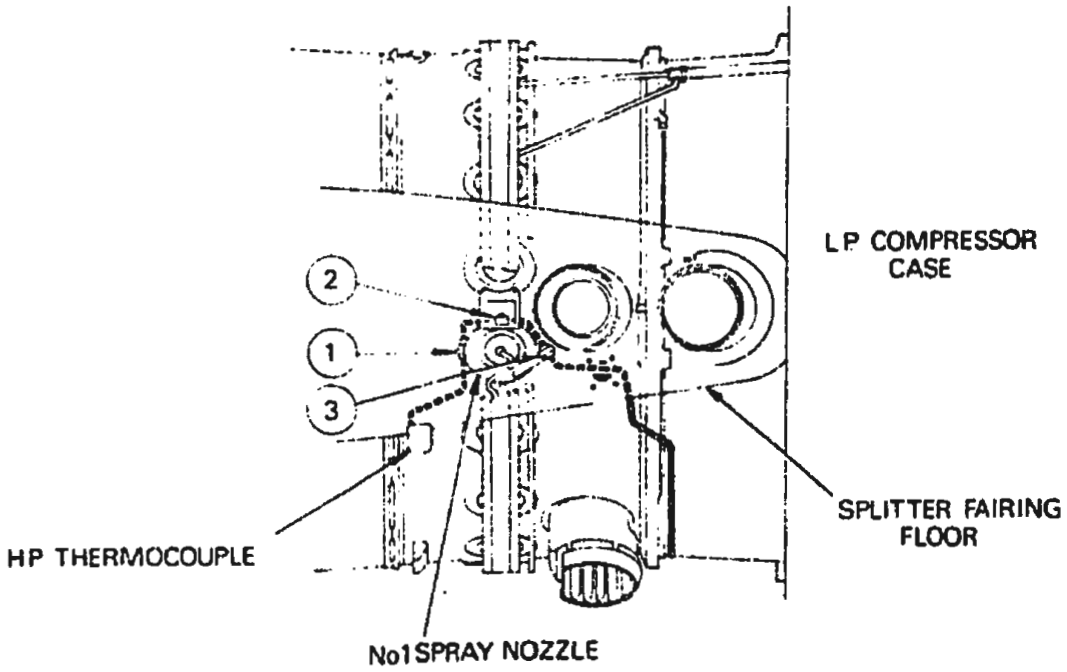


M1–5000–75–414
30748

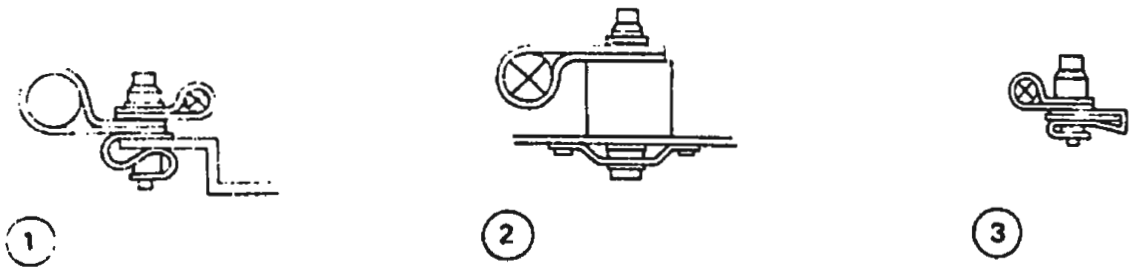
Thermocouple Harness Securing Clip Details
Figure 403 (Sheet 2)

R
R
001R

EFFECTIVITY: ENGINES WITHOUT RR SB72-3310



VIEW ON A FIG. 401



32564
M1-51000-75-41E

HP Thermocouple Harness Disconnect Points and Securing Clip Details
Figure 403

R
R
001R

EFFECTIVITY: ENGINES WITH RR SB72-3310

TURBINE TEMPERATURE AIDS - DESCRIPTION AND OPERATION

1. General

The temperature of the engine cooling and sealing air (Ref. 72-02-00) is continually sensed by thermocouples that provide electrical signals, proportional to the temperature of sampled air, for input to the Aircraft Integrated Data System (AIDS).

The engine-mounted units of the system (Ref. Fig. 1) consist of two identical thermocouples mounted on the LH side of the intermediate-pressure (IP) turbine outer case, zones 412, 422, and 432. Each thermocouple is positioned so that it senses the temperature of the air conveyed by internal sampling tubes from the front and rear faces of the IP turbine rotor.

R On engines with RR SB72-4677,
R the I.P. turbine rearface sampling tubes and thermocouple are deleted. The airflow passes through the body of the thermocouple and over the sensing element before passing through external tubes to the differential expansion switches of the Engine Cooling Air Overheat Indicating System (Ref. 77-22-00). Each thermocouple is connected by two terminal posts through the engine electrical harness (Ref. 71-50-00) to the aircraft electrical system.

2. Intermediate-pressure Turbine Temperature Thermocouple

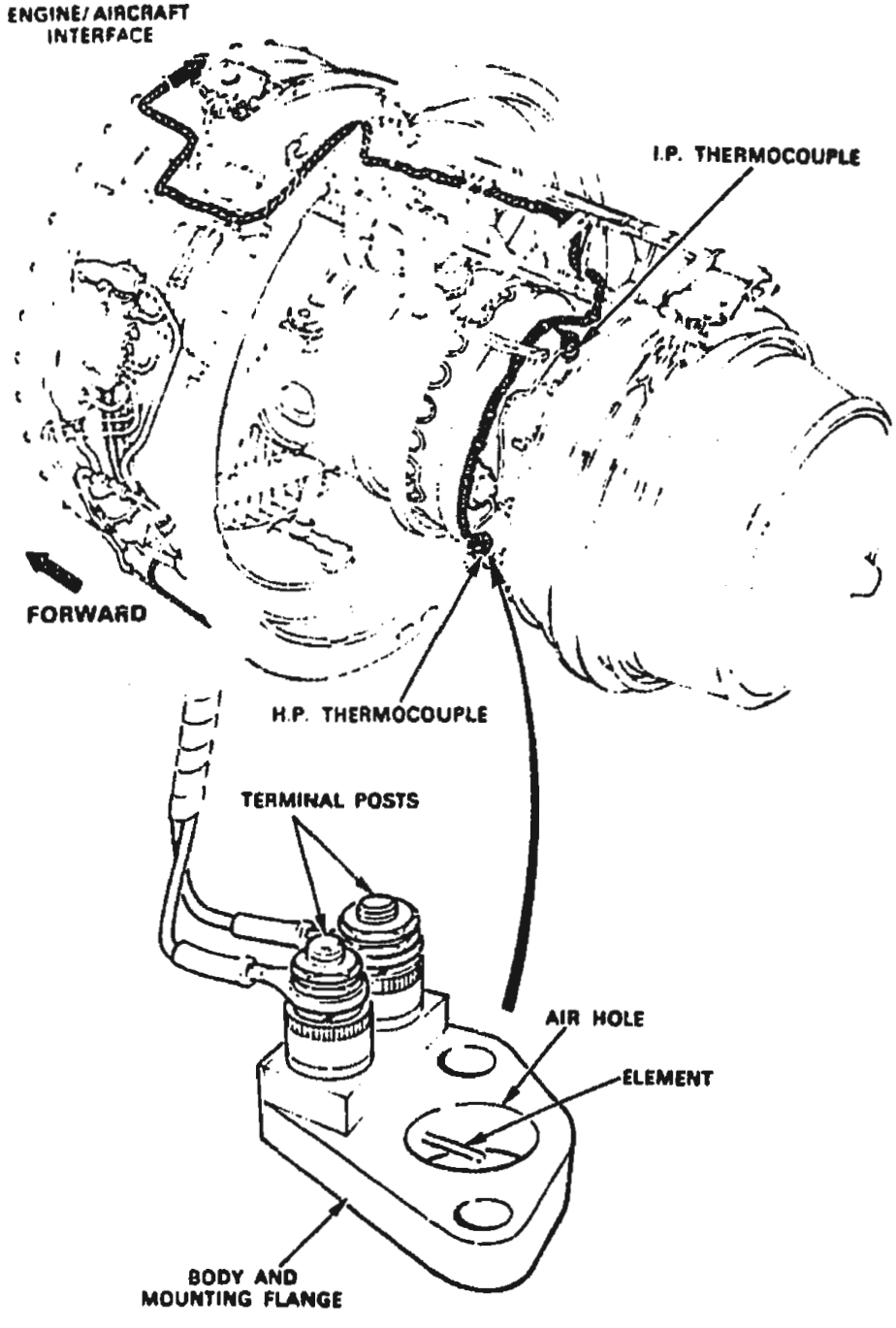
A. Description and Operation

The IP turbine temperature thermocouple is located on the upper LH side of the IP turbine outer case, zones 412, 422, and 432. The thermocouple assembly (Ref. Fig. 1) has a metal body and mounting flange, two terminal posts, and an element of two dissimilar metals enclosed in a metal sheath. The element protrudes into a mounting flange airhole. Sampled air flows to the differential expansion switches through this opening. The cooling air sample flows over the thermocouple element junction, producing a voltage proportional to the temperature of the sampled air.

R on engines with RR SB72-4677,
R the thermocouple assembly is deleted.

3. High-pressure Turbine Temperature Thermocouple

A. Description and Operation



HH 9217
M1-5000-75-011
25038A

Turbine Temperature AIDS Thermocouples
Figure 1

The high-pressure (HP) turbine temperature thermocouple is located on the lower LH side of the intermediate-pressure IP turbine outer case, zones 412, 422, and 432. The thermocouple is identical to the IP turbine temperature thermocouple (Ref. Para. 2) in physical and functional characteristics.

Although the thermocouple is referred to as sensing the temperature of the HP turbine cooling air, it actually senses the temperature of the cooling air from the front face of the IP turbine rotor.

INTERMEDIATE-PRESSURE TURBINE TEMPERATURE THERMOCOUPLE REMOVAL AND INSTALLATION

1. Equipment and Materials

Splitter Area Access Work Platform, Rolls-Royce Ltd., PN CP20309, or XUT.37594, or equivalent

Lock-wire, Fed. Spec QQ-W-390, 0.032-inch diameter, or equivalent

Protective caps

2. Referenced Procedures

70-51-00	Torque Technique - Maintenance Practices
72-03-00	Gas Generator Fairings - Removal and Installation
77-22-01	Differential Expansion Switch - Removal and Installation
78-30-00	Thrust Reverser - Maintenance Practices

WARNING: ENSURE THRUST REVERSER SYSTEM IS LOCKED IN FORWARD THRUST POSITION (REF. 78-30-00) WHILE WORK IS IN PROGRESS.

3. Removal/Installation

A. Removal

(1) On the Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag applicable circuit breakers ENG TURBINE OVHT DETECTION A, B, and IND, (M1, M2, and M3, or M7, M8, and M9, or M13, M14, and M15) and AIDS/FLT RCDR DC (H10).

On pilots overhead circuit breaker panel CB1, zone 210, open and tag applicable circuit breakers THRUST REVERSE (H16, H17, or H18) and ENGINE START CONT (E13, E14, or E15).

(2) On pilots center console, zone 210, install warning tags on applicable power control and thrust reverser levers, and on APU/GROUND AIR TO REVERSER toggle switches.

(3) Gain access to applicable engine isolation valve by opening panel 511LB-3 for engine No. 1, 611LB-3 for engine No. 3, or 471AL for engine No. 2.

(4) Verify that isolation valve is in closed position (external arm in position C).

(5) Remove threaded lockout pin from stowed position, install it through hole in external arm screwing it securely into valve body, and tag with REMOVE BEFORE FLIGHT streamer.

(6) Install thrust reverser mechanical locks (Ref. 78-30-00).

(7) Position splitter area access work platform in cold stream collector nozzle, zone 435.

(8) Remove turbine section lower and LH side gas generator fairings (Ref. 72-03-00).

(9) Remove LH rear access panel and nozzle box flange LH access panel from the interservices fairing (Ref. 72-03-00).

R (10) Disconnect terminal connector (Ref. Fig. 401) and cooling air sensing tube bolts.

R (11) On engine without RR SB72-2919,
R disconnect lower end of cooling air sensing tube, and loosen clip at tube support location.

R (11) On engines with RR SB72-2919 (HP/IP case connection ducting),
disconnect air sensing tube connector and remove seal
R plate bolts and nuts (Ref. Fig. 401).

(12) Move cooling air sensing tube clear of thermocouple.

(13) Remove thermocouple; reinstall one sensing tube bolt to retain inner tube in position.

(14) Install protective caps on tube ends and on thermocouple openings.

B. Installation

(1) Verify that circuit breakers opened in Step 3A(1) are open and tagged.

(2) Verify that warning tags installed in Step 3A(2) are in place.

(3) Verify that lockout pins installed in Step 3A(5) are in place.

(4) Verify that thrust reverser mechanical locks installed in Step 3A(6) are in place.

(5) Verify that work platform installed in Step 3A(7) is in place.

(6) Remove protective caps from thermocouple opening and tube end.

(7) Remove one bolt installed in Step 3A(13), ensuring that inner tube is not displaced from its correct position.

(8) Install turbine temperature thermocouple and cooling
R air sensing tube. Install bolts finger-tight (Ref.
R Fig. 401).

R (9) On engines without RR SB72-2919,
R install harness clipping bracket then connect lower end of air sensing tube to differential expansion switch mixing block (Ref. 70-51-00) and lock-wire (Ref. Fig. 401).

R (9) On engines with RR SB72-2919,
install and secure seal plate bolts and nuts then connect and tighten air sensing tube (Ref. 70-51-00)
R and lock-wire (Ref. Fig. 401).

(10) Torque thermocouple bolts and connect wires to terminals.

NOTE: To prevent incorrect assembly, terminal posts are different sizes.

(11) Install nozzle box flange LH access panel and LH rear access panel on interservices fairing (Ref. 72-03-00).

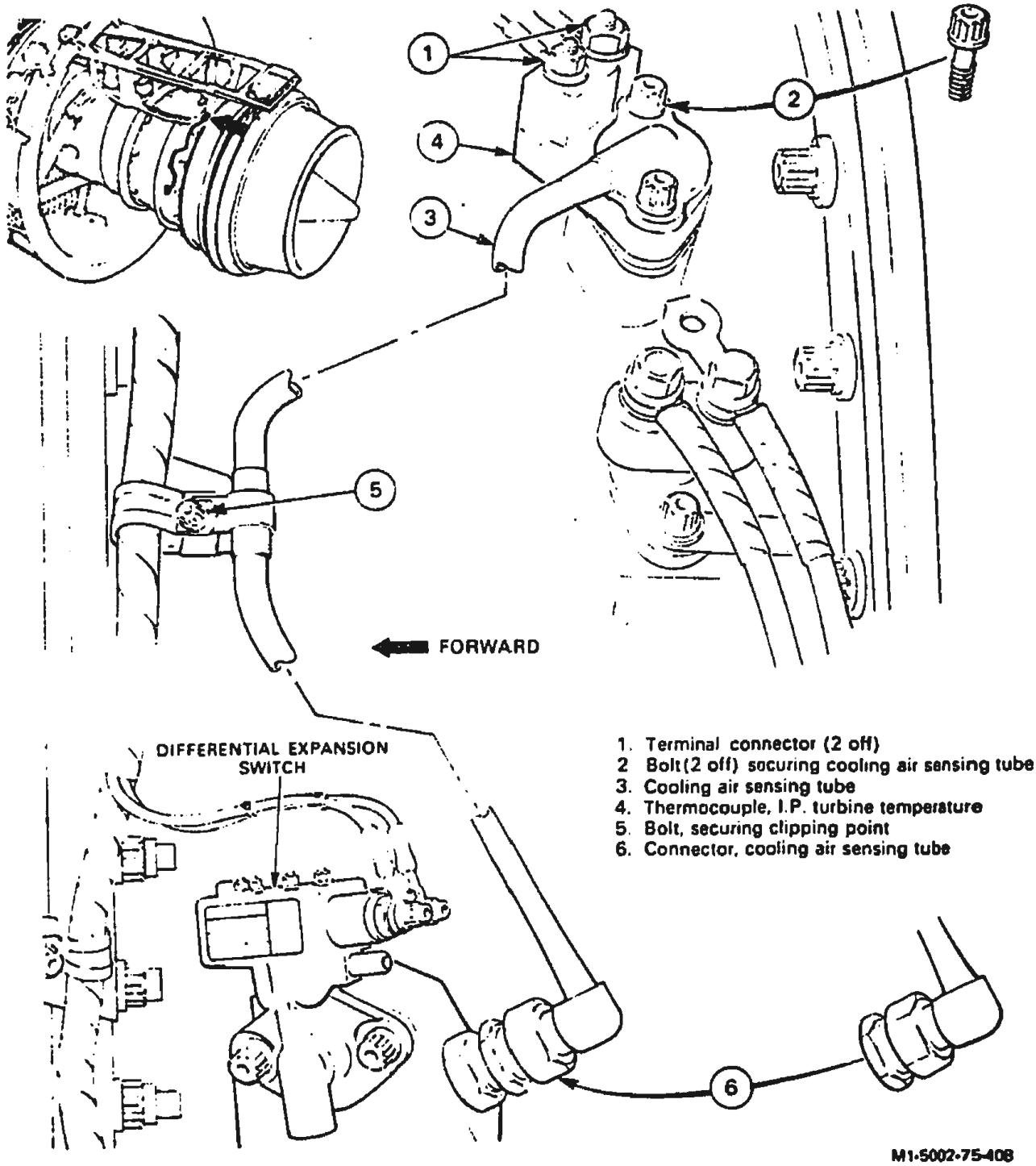
(12) Install turbine section lower gas generator and LH side fairings (Ref. 72-03-00).

(13) Remove work platform from cold stream collector nozzle.

(14) Remove mechanical locks installed in Step 3A(6).

(15) Remove and stow lockout pin and streamer installed in Step 3A(5).

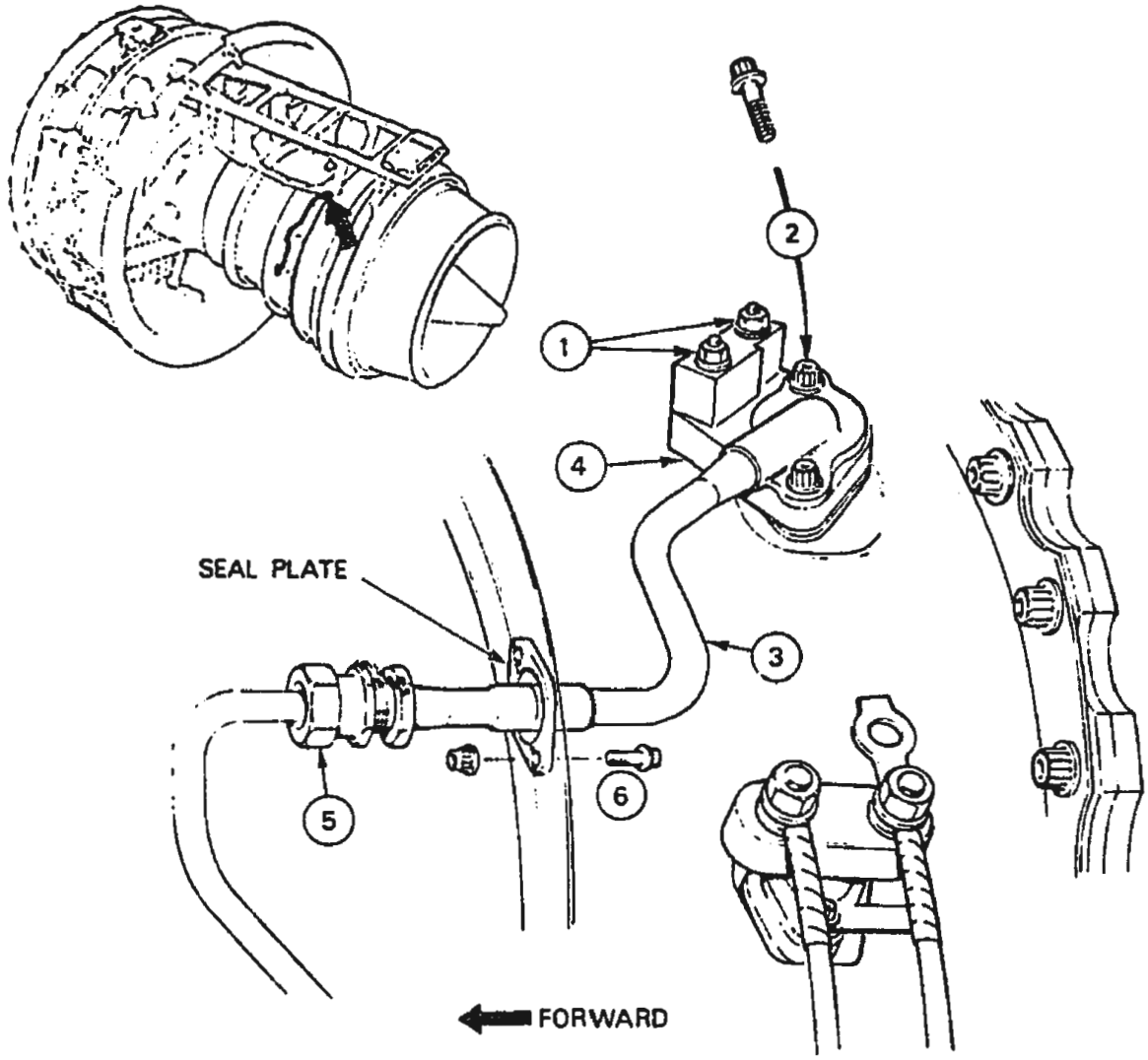
(16) Verify that access panel opened in Step 3A(3) is closed.



R R R IP Turbine Temperature Thermocouple
Removal and Installation
Figure 401

EFFECTIVITY: WITHOUT RR SB72-2919

001R



1 Terminal connector (2 off)
2 Bolt (2off) securing cooling air sensing tube
3 Cooling air sensing tube
4 Thermocouple, I.P. turbine temperature
5 Connector, air sensing tube
6 Bolt and nut (2off), securing seal plate to cooling shroud diaphragm

M1-5000-75-411
30270

R
R
R
IP Turbine Temperature Thermocouple
Removal and Installation
Figure 401

EFFECTIVITY: WITH RR SB72-2919

001B

(17) Remove warning tags installed in Step 3A(2).

(18) Remove tags and close circuit breakers opened in Step 3A(1).

HIGH-PRESSURE TURBINE TEMPERATURE THERMOCOUPLE REMOVAL AND INSTALLATION

1. Equipment and Materials

Splitter Area Access Work Platform, Rolls-Royce Ltd., P CP20309, or equivalent

Lock-wire, Fed Spec QQ-W-390, 0.032-inch diameter or equivalent

Protective caps

2. Referenced Procedures

70-51-00	Torque Technique - Maintenance Practices
72-03-00	Gas Generator Fairings - Removal and Installation
77-22-01	Differential Expansion Switch - Removal and Installation
78-30-00	Thrust Reverser - Maintenance Practices

3. Removal/Installation

WARNING: ENSURE THRUST REVERSER SYSTEM IS LOCKED IN FORWARD THRUST POSITION (REF. 78-30-00) WHILE WORK IS IN PROGRESS.

A. Removal

(1) On the Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag applicable circuit breakers ENG TURBINE OVHT DETECTION A, B, and IND, (M1, M2, and M3, or M7, M8, and M9, or M13, M14 and M15) and AIDS/FLT RCDR DC (H10).

On pilots overhead circuit breaker panel CB1, zone 210, open and tag applicable circuit breakers THRUST REVERSE (H16, H17, or H18) and ENGINE START CONT (E13, E14, or E15).

(2) On pilots center console, zone 210, install warning tags on applicable power control and thrust reverser levers, and on APU/GROUND AIR TO REVERSER toggle switches.

(3) Gain access to applicable engine isolation valve by opening panel 511LB-3 for engine No. 1, 611LB-3 for engine No. 3, or 471AL for engine No. 2.

(4) Verify that isolation valve is in closed position (external arm in position C).

(5) Remove threaded lockout pin from stowed position, install it through hole in external arm screwing it securely into valve body, and tag with REMOVE BEFORE FLIGHT streamer.

(6) Install thrust reverser mechanical locks (Ref. 78-30-00).

(7) Position splitter area access work platform in cold stream collector nozzle, zone 435.

(8) Remove turbine section lower and LH side gas generator fairings (Ref. 72-03-00).

(9) Disconnect terminal connectors (Ref. Fig. 401) and remove cooling air sensing tube bolts.

(10) Disconnect cooling air sensing tube from differential expansion switch and remove the tube.

(11) Remove thermocouple; reinstall one bolt in the mounting flange to retain inner sleeve in position.

(12) Install protective caps on tube ends and on thermocouple openings.

B. Installation

(1) Verify that circuit breakers opened in Step 3A(1) are open and tagged.

(2) Verify that levers and toggle switch tagged in Step 3A(2) are tagged.

(3) Verify that lockout pins installed in Step 3A(5) are in place.

(4) Verify that thrust reverser mechanical locks installed in Step 3A(6) are in place.

(5) Verify that work platform installed in Step 3A(7) is in place.

(6) Remove protective caps from thermocouple opening and tube end.

(7) Remove bolt installed in Step 3A(11), ensuring that inner sleeve is not displaced from its correct position.

(8) Position HP turbine temperature thermocouple on mounting flange, position lower end of air sensing tube on thermocouple, and replace bolts. Install bolts finger-tight (Ref. Fig. 401).

(9) Connect upper end of air sensing tube to differential expansion switch mixing block (Ref. 70-51-00), and lock-wire.

(10) Torque thermocouple bolts and connect wires to terminals.

NOTE: To prevent incorrect assembly, terminal posts are different sizes.

(11) Install nozzle boy flange LH access panel and LH rear access panel on interservices fairing (Ref. 72-03-00).

(12) Install turbine section lower gas generator and LH side fairings (Ref. 72-03-00) and remove work platform from cold stream nozzle.

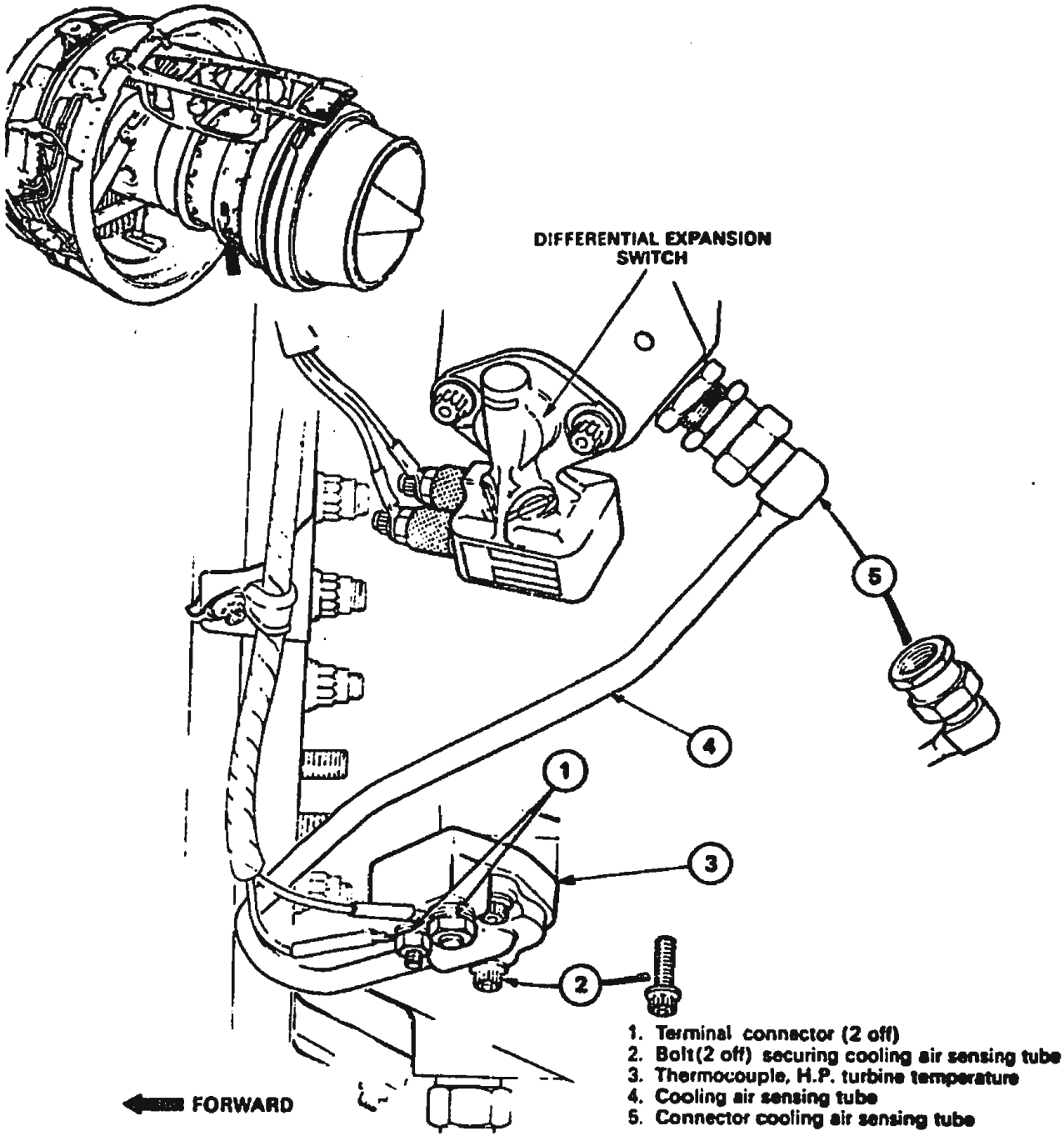
(13) Remove mechanical locks installed in Step 3A(6).

(14) Remove and stow lockout pin and streamer installed in Step 3A(5).

(15) Verify that access panel opened in Step 3A(3) is closed.

(16) Remove warning tags installed in Step 3A(2).

(17) Remove tags and close circuit breakers opened in Step 3A(1).



High-pressure Turbine Temperature Thermocouple
Removal and Installation
Figure 401

EFFECTIVITY: ALL